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(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

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AND

GENERAL SCIENCE.

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THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Thirty-Second Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Dec. 26th, 1901.

The Thirty-Second Annual Meeting of the New England Association of Gas Engineers will be held in Boston, February 19 and 20, 1902. The headquarters will be in Youngs' Hotel as usual; but, owing to the increased attendance at the meetings, which necessitates the securing of a larger assembly room, the sessions will be held in the Parker House.

A lively interest in the meeting is being shown by members, and the programme in detail will be issued later. W. W. GIFFORD, Sec'y.

[OFFICIAL NOTICE.]

Ohio Gas Light Association—Novelty Advertising Department.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE SECRETARY,
DELAWARE, O., Dec. 24, 1901.

Members of the Ohio Gas Light Association are earnestly requested to send to Mr. B. W. Perkins, South Bend, Ind., any contribution they may have for the Novelty Advertising Department of the Association. This is a most favorable time, just at the close of the season, when the many successful methods of advertising tried during the year are still fresh in the minds of those who used them. T. C. JONES, Sec'y.

BRIEFLY TOLD.

THE OLD YEAR AND THE NEW.—When this issue of the JOURNAL reaches its readers the second year of the new century will be well underway, and it is our good satisfaction to heartily say to them that we hope and believe the second year of the century has as much good in store for them as did its predecessor. For no one may truthfully deny that 1901 was a profitable one for those engaged in the supplying of light from central stations. At the outset impending unrest amongst labor threatened serious trouble, but happily the employers and the employed adjusted their differences in manner agreeable to both—and, to their greater credit, without open rupture at any important point. Another cloud that promised to seriously darken the gas man's horizon was the seeming tendency to material increases in the prices of supplies, and while that cloud did spread a trifle, in the end reason prevailed on the part of the sellers of such to curtail their demands in some sort of fair measure. Combination and consolidation have been kept up, and the result of the same may be counted rather in the light of benefit to the industry than otherwise; at least from the standpoint of the engineer, who should never be held responsible for the vagaries of his financial directors. Our reports from various points all go to show noted increases in sendout, and the fair average gain in this respect for 1901, as compared with that for 1900, may safely be put at 8 per cent. the country over. The main development from an engineering point of view is in the line

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of inclined retorts; for the last month of the year witnessed the closing of two important contracts in such respect—one for the works of the Central Union Gas Company, of this city, the other for the works of the Lynn (Mass.) Gas and Electric Company. Much new work in the extending and rehabilitating of old plants has been completed or is underway, and the planning for such account in the near future is greater now than at any other time for the past 10 years. During the year five plants were completed in places that had never been supplied with artificial gas, and it is quite certain that at least as many more are now beyond the projection stage. Take it all-in-all, the business is in a healthy state, and in such belief we congratulate our readers over that which the future holds for them, and thank them for their steadfast support of our efforts to be of benefit or use to them.

DEATH OF MR. A. L. ALLEN.—Mr. Augustus L. Allen died at his home in Poughkeepsie, N. Y., the morning of December 26th last, in his 93d year. The funeral services were held at his late residence, the morning of December 28th, and subsequently his remains were placed in Woodlawn Cemetery. This brief intimation may not appeal very forcibly to the present generation of gas men, but 20 years ago Mr. Allen was very much in evidence in the gas world through his exploitation of the Allen-Harris process of manufacturing water gas. Born in Fort Plain, N.Y., Aug. 23, 1809, his studies were finished in the Union College, Schenectady, N.Y., from which institution he graduated in 1835. Electing to follow the legal profession, he was in due time admitted to the bar (Albany, N.Y.), and in 1837 removed to New York where he speedily acquired a successful practice. In the early seventies he became interested in the manufacture of gas, and, in conjunction with Mr. George S. Harris, evolved the Allen-Harris system of manufacturing water gas. Failing to interest any particular company in its practical exploitation, he secured a franchise for the operation of the Citizens Gas Company, in Poughkeepsie, N. Y., which Company was operated on the Allen-Harris process lines for some years, with rather indifferent success. The plant and franchises were eventually purchased by the owners of the Poughkeepsie Gas Company. He was elected to membership in the American Gas Light Association, October, 1875, and for a decade of years was prominent at its meetings. He is survived, we think, by his wife, to whom he was married in 1843. It might also be said that Mr. Allen was one of the original Trustees of Vassar College, Poughkeepsie.

DEATH OF MR. P. T. BURTIS.—The death of another member of the fraternity, well-known to the gas men of 20 years ago, occurred the morning of December 14th, when Peter T. Burtis, for many years Superintendent of the old Chicago Gas Light and Coke Company, passed away. He died in Phœnix, Arizona, after an illness of long duration—in fact his removal to Phœnix was prompted by the hope that its climate would be beneficial to him. He served the Chicago Gas Light and Coke Company with rare fidelity and zeal for 20 years or more, in fact up to the time when the late Mr. Theobald Forstall was appointed the Company's General Manager, in 1882. He was elected to membership in the American Gas Light Association, at the meeting held in October, 1879.

NOTES.—The East Boston (Mass.) Gas Company has installed a double set of 5-foot apparatus of the United Gas Improvement Company's type, which is to be used as an auxiliary and enriching machine. The Company has also completed a new stack of 4 benches of 6's, the water gas set having replaced 4 benches of 6's that were located in the old retort house. The new benches were constructed by Messrs. J. H. Gautier & Company, of Jersey City, N. J., and are of the Flemming half-depth furnace type.——"The application of the Mobile (Ala.) Light and Railroad Company for an opposition gas franchise in Mobile has been defeated. In spite of the efforts of the Mobile Light and Railroad Company to have the city advertise for bids for the lighting of the streets, the General Council has accepted the proposition of the Electric Lighting Company of Mobile (the latter is controlled by the Mobile Gas Light and Coke Company) to carry on the work for 5 years, at the rate of $75 per lamp per year. That Company has been lighting the streets for 15 years. The Mobile Gas Light and Coke Company is making notable improvements on its plant. The betterments include an additional set of condensers and scrubbers, and an up-to-date system of purifying apparatus.—S."——The proprietors of the Pittsfield (Mass.) Coal Gas Company have established a new selling rate. The gross rate per 1,000 cubic feet is $1.50, with 10 per cent. off for prompt payment—which means a concession of 35 cents from the old rate. The Company has established offices and a showroom in the Bowerman building on South street. Some important changes in the executive management will shortly be announced.

[Prepared for the JOURNAL, by "G. D. R."]

The Lights of the Pacific Coast.

The Big Petroleum Oil Pipe Line Underway.—Your correspondent visited the extensive plants of the Standard Oil Company on the Pacific Coast, where something like 100 great oil storage tanks are being erected, with necessary piping to fill them with oil over the hills from the oil sections many miles away. More than a million dollars are to be invested in the enterprise, and when finished the city of San Francisco, and very many other cities and towns of California, will be abundantly furnished with illuminating oil at moderate costs. The 100 tanks in process of construction near the city of San Francisco will have a capacity to store over 3,000,000 gallons of oil. The tanks are being built according to the best of modern design, by competent engineers, and no expense is spared to have the equipment first-class in every respect. Work on the putting in of the vast amount of piping for conveying the oil to the Coast has been begun, but the engineers say that it will be more than a year before the extensive system is completed. There are mountains and hills to get the oil over, and this is a great engineering problem in some instances.

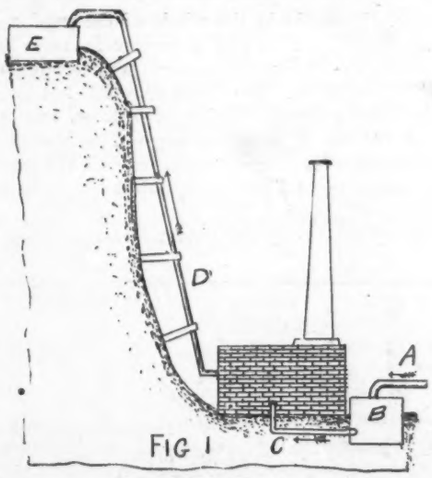
Moving the Oil Current Over an Elevated Point.—The writer secured plans of the different modes which it is calculated to employ in transporting the oil over high elevations. Pumping machines will be employed on the one side of the hill or mountain to raise the oil to the top, and the oil will run down the other side in the pipe by its own gravity. In Fig. 1 is shown a rough sketch to give an idea of the way in which the illuminating oil will be conveyed over the hills and mountains. The pumping machinery is in the brick building at the base of the hill. The steam power plant is in the building also, for running the pumping apparatus. The oil comes to this point by gravity through the pipe *A*, and falls into the tank *B*. The object now is to get the oil to the top of the hill to the tank *K*. The pumping machinery connections are made and the oil is drawn from the tank *B*, by means of the pipe *C*, into the cylinders of the force pumps, and is thence conveyed up the pipe line *D* to the upper tank *E*. If this is the highest elevation of the hill or mountain, the pipe line merely runs down grade from this tank to the next elevation where a similar pumping station is situated. In case that this elevation is only part way up the hill, then another relay of pumping is required. In some localities two or more relays of pumping stations will be needed. In some cases it is calculated to have the piping station at the top of the elevation and then the oil will be drawn up instead of forced up. Another plan involves both the drawing up to a central point and then a forcing up the rest of the way, with the pumps situated half way up the incline.

Straining Petroleum Oil.—I observed a straining device for illuminating oil which appeared to be novel, and present it in Fig. 2.

This device is constructed on a large scale, and is calculated to strain a considerable quantity of oil, removing therefrom foreign substances which are pretty sure to clog pipes and produce trouble along the line. The device consists of the inlet pipe *F*, through which the oil pours to the first receiving tank *H*, through the droops *G G*. This tank, which is constructed of masonry, is bored through with a series of small holes at *I I*, indicated by the black lines. These holes are capped with cup shaped metal pieces, which pieces are drilled with still smaller holes than those in the base of the tank. The oil is strained of all foreign and loose substances as it passes through these holes in the cups to the bottom vessel *J*, and thence to the main line of piping again through pipe *J*. The cups are removed occasionally for the cleaning out of the collected debris.

Strengthening the Pipes.—It is very essential that the metal pipes be protected in some way when used in the mountainous sections for conveying oils. The processes of adding to the resisting properties of the pipe lines in the hills are numerous, and experiments continue to develop still other ways. In Fig. 3 is shown a mode employed with effective results, consisting in employing bands of steel, *M*, at intervals, which bands are secured together by means of the rod *L*. This rod passes through the projections or lips of the different bands, and at intervals the bands are fitted with nuts on the rods. These lock nuts hold the bands very firmly in position.

Process of Lighting.—There have been a number of changes for the better in the line of street, house and factory lighting on the Pacific Coast since your correspondent was last here. Very many of the street lights are now provided with the Welsbach pattern mantles, producing a white light much better for the illumination of the streets than the plain types of lights formerly used. Electricity is, of course, utilized very largely in all street, house, hotel, office and shop service, but the mantle lights, with both gas and oil, are quite prominent. San



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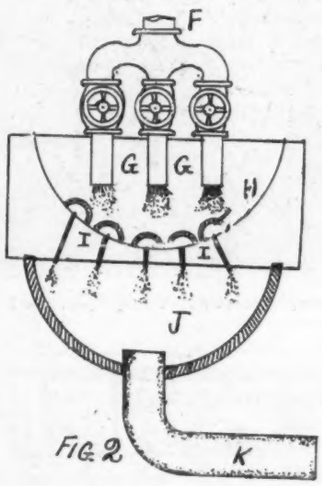

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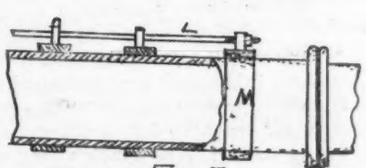


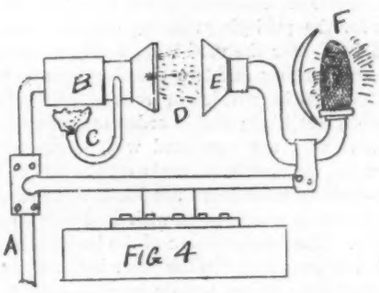
FIG 3

Conveying Illuminating Oil Over Elevations in California.

Francisco is liberally illuminated at night by the extensive showing of advertising signs, many of which are lighted by electrical currents and some by other means of lighting. In Fig. 4 is shown a type of vapor light used for lighting where intensity is required, and is adapted for advertising signs of intricate design, reflectors for special uses, and the like. The oil is fed through the pipe *A*, to the stand-piece *B*, where the oil is vaporized by the heat from the flame *C*. This flame is fed with illuminating material in the form of the vapor, by the discharges of vapor obtained from the oval outlet as shown. The most of the vaporized oil passes in the direction of the arrow onto the opposite receiving tunnel *E*. The space between the outlet and the receiving tunnel is indicated at *D*, and this space affords the vapor a chance to mix with the air which is needed to render the oil suitable for burning at a white heat on the mantle *F*. The pipe carrying enough of the oil vapor to the flame to keep flame going is marked *C*. In some cases a pressure on the oil is obtained by pumping air into the tank holding the oil, and this greatly adds to the brilliancy of the light.

Revolving Device for Show Purposes.—In Fig. 5 is shown a contrivance I observed in use in an establishment for making a display of lighting for advertising. It is constructed with a circular section of pipe, which pipe runs with a wheel motion, there being a hub provided that is hollowed for a pipe for conveying illuminating oil from a central point to the rim of the wheel. The course of the oil is then through the spokes, which are hollow tubes. The oil is fed from a supply tank to the central pipe to the hub. From the rim, the oil oozes forth through the miniature nozzles, which are adjusted about the wheel as shown. The speed at which the wheel is revolved causes the lighted flames to break and distribute over considerable space, something after the fashion indicated in the view. The wheel is turned by the cord *G*, which cord is run from a motor. This device attracts quite a lot of attention to the exhibition window.

Conveying Pipes.—The writer examined some of the various forms of pipes employed in the State of California for petroleum oil, and gives in the next 3 cuts views of some of the odd styles. The ordinary form of metal piping is too well known as to its pattern to require observation. In the styles of pipes presented, the one in Fig. 6 is built up of sections of lumber, the pieces being set onto each other and matching according to a general plan as shown. Each piece is secured to the other by wood pins, and when the pieces are set up they are banded with metal rings. Fig. 7 shows a design of masonry piping which has been used in the California oil regions with good results; although it it, of course, not portable and possesses the disadvantage of being more costly in building than the average metal pipe line. It is useful for short distances in yard work and for places where metal piping would not be adaptable. I saw some of this style of brick pipes in service for carrying oil under a body of water where a tunnel had been put in, as the pipes which had been laid on the bottom of the stream had been torn out by the anchors of shipping craft frequently. Fig. 8 shows



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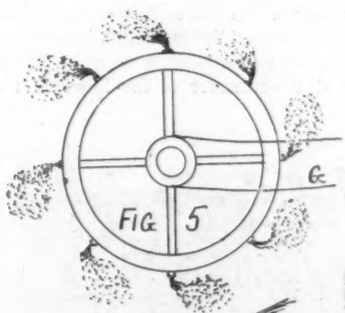


FIG 5

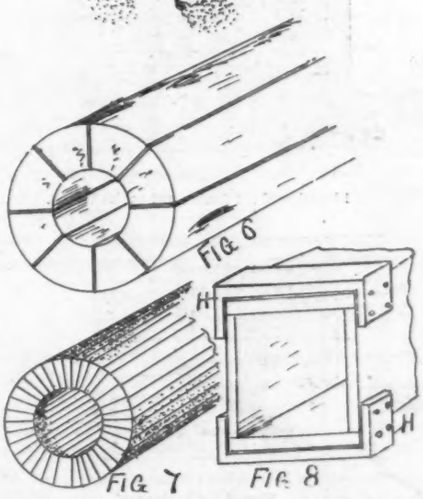


FIG 6 FIG 7 FIG 8

Illustrating Some of the Lighting Facilities of the Pacific Coast.

still another pattern of oil box-piping made with sawed lumber sides and top and bottom, each piece being wire nailed or set screwed to place.

After the sides are set on, the pieces *H H*, which are cast iron, are screwed to position, making the parts very secure.

[Continued from Vol. LXXV., Page 1047.]

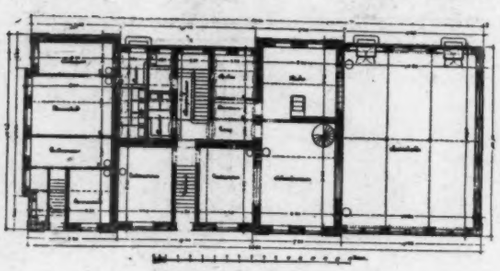
The Vienna Municipal Gas Works.[1]

Workmen's Lobbies and Lavatories, Offices and Dwellings, Main Testing Station, Workshops and Stores.—The coal is unloaded from the railway trucks and stacked; and the coke prepared and sold (for the present) through a contractor, who is responsible for the arrangements of the men engaged in this work. The largest number of other men so far employed by the Municipality at the gas works is 1,400, and the smallest 600, on one day. The engine and boiler men and the workshop hands have accommodation provided in parts of the buildings in which they work. The workers in the retort house have dressing rooms, lavatories, and bath rooms in temporary annexes on the two sides of the house. The washing arrangements include foot and shower baths and large porcelain wash basins, set in iron tables with Monier slabs, and filled and emptied in batches by an attendant. On the front of the house facing the coal yard, there are also 9 annexes, each with a waiting room for the workmen, 23 feet long and 15 feet wide. In these annexes, but separated from the works' rooms, and communicating with the open by a passage 7 feet 10 inches wide, are the closets and urinals, with ample flushing arrangements. The waiting rooms have the advantage that the men can rapidly get to and from their work; while too great numbers are not congregated in one room.

Dressing rooms for the purifying men are provided in a part of the tar handling building. For the yard men, a special temporary building, containing two waiting and two dressing rooms, each 32 feet 9 inches by 26 feet 3 inches, is provided in front of the meter house. The dressing rooms are 23 feet high; and in order to overcome the sanitary objections to lockers, they are furnished with hooks for the clothes, which are drawn up, by means of cords on the walls, nearly to the ceiling. In each dressing room there are 358 of these hooks. Between the two dressing rooms is a bath room with foot baths, and 20 hot and 6 cold shower baths. The manipulation of the baths is put in charge of an attendant, as it has been found in the other bath rooms that even the most substantial appliances do not remain in good order if manipulated by the workmen themselves. On the first floor, and at the entrances, are offices and pay rooms. In the middle of the whole building is a high, airy room, with overhead lights, containing closets and urinals.

On one of the approach roads, leading from the Eleventh District to the gas works, and at the entrance of the latter, is a restaurant and

Elevation of the Restaurant on the Works.

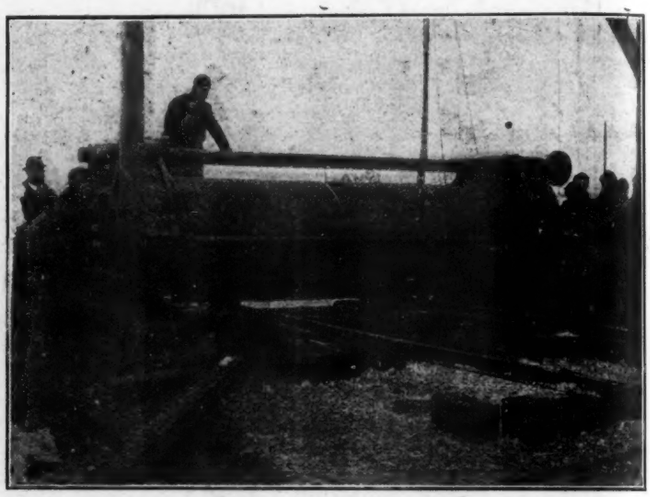


Plan of the Restaurant.

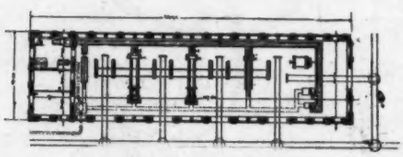
dwelling house. The dining room for workmen is on the ground floor in the annex; while the restaurant and 4 rooms for watchmen are in the main building, with dwelling rooms for the restaurant keeper and foremen overhead.

The offices are in a building adjoining the coke yard, and opposite the retort house. It overlooks the whole of the yard and apparatus houses. Subsequently, a road will be constructed from the Third District of the city to the gas works, where it will terminate in an open space in front of the offices. The building is 223 feet long and 57 feet wide. It comprises a central portion of 3 floors, and 2 wings of 2 floors. The second floor is for the residence of the Manager. The first floor contains quarters for four other officers. On the ground floor are the cashier's office, the laboratory, quarters for a bachelor doctor, surgery, and porter's rooms

It was necessary to make special arrangements for testing the pipes for



Temporary Apparatus for Testing Pipes at the Foundry.



Plan of Pipe Testing Station.

the gas mains, in view of the distributing system throughout the city having to be completed in the short time at disposal. A few large pipes were tested by temporary apparatus at the foundry (see photo.); but this took up much time, and necessitated the sending out of officials from the city staff. A testing room, 123 feet 4 inches long and 34 feet 5 inches wide, was therefore erected, and equipped with four sets of apparatus for testing main pipes of from 2 to 48 inches in diameter, by means of water under pressure. Two sets can always be used for one and the same kind of pipe. The room also contains a press for testing gas valves by means of air and water, and also apparatus for testing bends. Lengths of pipe from 32 inches to 13 feet, according to the diameter, can be tested with the apparatus. The latter is operated by means of a vertical tube boiler 7 feet 10 inches high, having three Galloway transverse tubes, and 74¼ square feet of heating surface, working at a pressure of 6 atmospheres.

This boiler operates a Worthington pump, which lifts water at the rate of 220 gallons per minute into two elevated reservoirs, each of 1,580 gallons capacity. A vertical engine, with a cylinder 4¼ inches in diameter, drives three single acting pumps, which deliver water up to 20 atmospheres pressure through an accumulator with plunger 8 inches and cylinder 10 inches in diameter, and a stroke of 8 feet 2¼ inches. The water, when run off from the testing plant, can be either discharged into the drains or pumped up into the elevated reservoir. Pipes, 48 inches in diameter and 13 feet long, were tested within 7 to 10 minutes apiece, and pipes of smaller size in less time. Between October 1, 1897, when the testing room started work, and July, 1899, 141,000 pipes, of a total weight of 40,330 metric tons, were tested. Of these, 3,500, weighing 1,034 metric tons, were rejected on account of faults. In addition, 158,444 gas pipes, weighing 26,608 metric tons, were tested at the municipal testing station at the water works, and 2,819 of them were rejected.

For making necessary repairs to apparatus on the works, there are provided shops in a building 150 feet 6 inches long and 67 feet wide. The machine tools in the shops are driven by a 35-horse power steam engine.

As stores, two buildings, each 75 feet 6 inches long and 39 feet 4

1. *Journal of Gas Lighting.*

inches wide, at the east end of the retort house, are provisionally employed. They are connected by an open shed; and some old buildings existing on the site of the works are also used as store rooms. Most of the large stock of main pipes are stored round about the pipe testing station. Gas meters, lanterns, and other articles connected with the distribution and sale of the gas are stored in 15 railway arches on the boundary of the Ninth and Nineteenth Districts of the city. In connection with this depot, is a small repairing shop and a gas meter testing station.

The Distributing System and Public and Private Lighting.—Herr Herrmann's original scheme embodied a distributing system substantially the same as that of the Imperial Continental Gas Association. As, however, the Association had 6 works, and no fewer than 27 mains emanating from them, their distributing system was clearly not the most suitable for supplying the same area from one large works, such as those now erected by the Municipality—unless, indeed, special storage stations were also employed. The distribution of the gas from one works, lying on one side of the city, required quite a different system of mains. In planning this system, it was necessary to bear in mind that the future extension of the city would probably be mainly towards the west—as is the case with most European towns—which is the side remote from the gas works.

The Municipal authorities had no definite information as to the amount of the gas consumption in the different quarters of the city; and they were not on such terms with the Association as would admit of it being obtained from that body. Hence, between January and August, 1897, a house-to-house enumeration of the number of burners, etc., was made; and this formed the basis of calculations as to the dimensions of mains required.

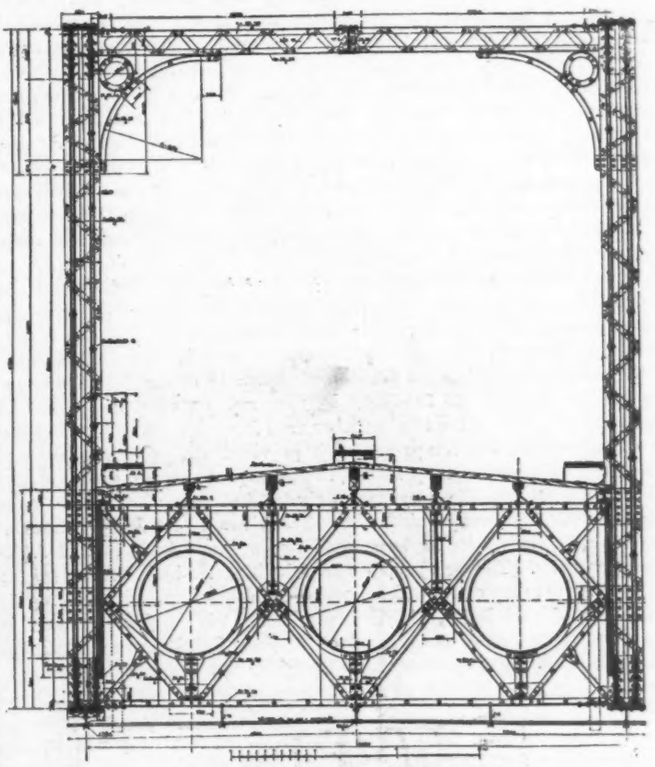
The district to be supplied varied much in level. Adjoining the Danube and the Danube Canal the land is flat, and rises only to a moderate extent, passing up-stream from the gas works. On the other hand, coming near the Danube Canal, is the margin of the plateau and eminence on which the greater part of the city of Vienna is built. They are separated by the low valley through which the Vienna river and streams, which are now covered over, run. Hence the area to be supplied was naturally cut up into several well defined districts, for which special pressure regulation would be required. In planning the laying of the distributing mains, it was necessary also to have regard to the time by which the pipes could be delivered. The German standards for the sockets, etc., were adhered to; and the greater part of the pipes were ordered of the United Bohemian-Moravian Iron Works, which undertook to deliver 22,500 metric tons yearly, in equal monthly deliveries up to March, 1899. Smaller quantities were to be supplied by other firms.

The scheme ultimately adopted provided for 6 mains to convey gas from the works to the city. One of these, supplying the Third District, which lies near the gas works on the northwest side, is 27½ inches in diameter. The Tenth and Eleventh Districts, lying immediately west and south of the works, are supplied by a main 43¼ inches in diameter. The remaining 4 mains are all nearly 48 inches in diameter. One passes in a nearly straight line through the Third to the Fourth District, which lies to the south of the central district of the city, and thence to outlying parts. The other three 48-inch mains cross to the left bank of the Danube Canal by a new bridge, since there was only room beneath the towing path on the right bank for the 27½-inch main for the Third District. One of the three supplies the part of the city which is on the left side of the canal; while the other two recross to the central district, and pass on to the outlying districts to the east of the town. The mains in the different districts are connected up, so that any section can be supplied from either end; but normally each distributing section is kept distinct, by closed valves on the connecting mains.

There are valves on the mains on either side of the bridges which carry them over the canal, and connecting mains so placed that any length of main traversing a bridge may be shut out in case of fracture. There is a difference of level of 330 feet between different parts of the distributing system. The system was based on the gas leaving the works at a pressure of 2.8 inches; and as the bell or inner lift of each gasholder alone throws a pressure of 4.9 inches, there is an ample margin for raising the distributing pressure to meet later requirements. For the present, in pursuance of the undertaking with the Imperial Continental Gas Association, the municipal distributing system is confined to the central districts within the former city boundary, the Eleventh District, and two suburbs. A group of small towns some distance away on the left bank of the Danube are also supplied through a main which has no service pipes for a distance of 8½ miles. The total length of mains laid is nearly 360 miles. The cubical content amounts to a little over 2,000,000 cubic feet. There are 15¼ miles of 48-inch mains, and 88 miles of 6 inch. The smallest size used is 2.8 inches, of which, however, there is but a small length laid.

The laying of the mains in the city was a matter of no small difficulty, owing to the great number of other pipes and drains in all the principal streets. The mains on the left bank of the Danube Canal were, in consequence of the bad nature of the subsoil, mostly laid on separate concrete blocks, with the sockets at the intervening spaces, in order to facilitate working at the joints. Where the soil was silt, it was removed, and the mains were laid on concrete resting on piles driven into the firm subsoil. Special attention was given to thoroughly ramming the material with which the trenches were filled up, in order that the laying of the mains should not leave evidences on the surface of the streets. The laying of the mains was for the most part finished by the end of 1898. The greatest length completely laid in one day was 3,280 yards.

The bridge which carries the trunk mains from the works over the Danube Canal is formed of two iron girders of hemi-parabolic form, having a span of 210 feet. They are 11 feet 6 inches high at the ends, and 27 feet 10 inches in the middle, and are placed 21 feet 6 inches apart. The top and bottom flanges of the girders are of **U**-pattern cross section. These two main girders are joined by 17 transverse lattice girders, 7 feet 8 inches high, in which the wrought iron gas mains are supported by means of bent angle irons. On the top of these transverse girders are seven longitudinal beams, which at present support a light roof, but later may be used to carry a plank bottom to enable the bridge to be used as a foot bridge. In the calculations for the bridge, allowance was made, apart from the weight of iron, for a traffic load of 82 pounds per square foot (see cross section of the bridge). A view of



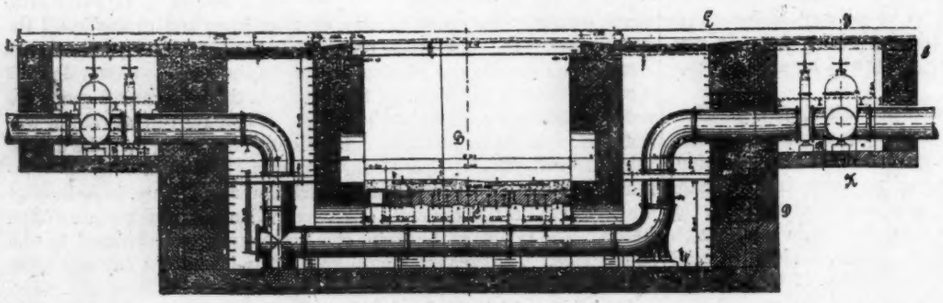
Cross Section Through Pipe Bridge.

the bridge was given in the *Journal* for April 2 last, p. 877. The mains on the bridge are of ¼-inch plate, in lengths of 13 feet 2 inches. They are not covered in, but are protected at the sides by cross bars, and at the bottom by galvanized corrugated iron sheets.

At the two abutment piers, there are erected small buildings to contain the vertical connections, cross connections and valves, stairs, and siphon pots. Provision for the dilatation of the mains is made by means of tripartite ¼-inch thick discs, 70 inches in diameter. The weight of the bridge is 175 metric tons, and that of the mains 64 metric tons. The whole of it was erected and finished in less than 12 months.

The main which crosses the principal stream of the Danube by Crown Prince Rudolph's bridge is provided with a stuffing-box device to compensate for dilatation. The public bridge by which two of the 48-inch

mains recross the Danube Canal to the central district of the city did not admit of circular pipes being employed, and hence rectangular mains were used on this bridge. These two 48-inch mains are carried under the city railway line, which lies in a thickly walled cutting, by



Detail of Pipes Crossing Under the City Railway.

means of a vertical shaft on each side of the line and a connecting tunnel. The tunnel is 19 feet 8 inches wide, and 8 feet 2 inches high. It is roofed, under the railway metals, with concrete arches between the girders 20 inches deep. The bottom and sides of the shafts and tunnel are of concrete; but the mains are weighted to prevent their displacement in case water should at any time flood the shafts and tunnel. The shafts, tunnel, etc., are shown in section.

Each section of main was tested for soundness, before being covered in, by air at 12 inches water pressure—soapy water being carefully applied to all the joints. In order to prevent any explosive mixtures collecting in the newly laid mains, through fractures which would inevitably occur in some places before the completion of the system, air was pumped into the finished sections, and maintained therein at considerably higher pressure than that of the gas in the Imperial Continental Association mains. For this purpose, four small pumping stations were erected. In order to facilitate the detection of leaks by smell, the air used was odorized by means of carbylamine; but this plan did not answer very well where the mains were at a considerable depth. At distances of 65 feet, perforated vertical pipes were carried from the top of the mains to the surface of the road, and covered with a perforated cap and cast iron box top. These ventilating pipes were packed with coarse ballast, in order to prevent explosions from escaping gas, and their mouths were put on the footways.

It was decided by the Municipality that the Welsbach light should be generally employed for public lighting; and arrangements for fitting the necessary burners were accordingly made with the Austrian Incandescent Company. The use of flat-flame burners is now confined to a few places where it has not yet seemed desirable to make the change. Actually, there are 442 flat-flame burners not yet displaced, which is only 2.1 per cent. of the total number used for public lighting. For the ordinary streets, the lamps are each provided with one incandescent burner; but in prominent positions, two burners are used in each lantern. The lamps are, on the average, nearly 100 feet apart; but the distance varies with the local requirements. There are 16,440 lamp columns, of which 4,560 are for lanterns with two or more burners, and 2,690 wall brackets. The service pipes are ¾ inch and 1 inch. At midnight 12,552 burners are extinguished; while 8,936 are kept alight all night. The base of each lamp column is cast separately; and the column is screwed to the base. The plans for the street lighting were drawn up by the Building Department of the city. At important crossings, bridges, etc., the old columns and lanterns were used, after having been adapted for the use of incandescent burners. A public competition, with prizes ranging from £8 to £85 in value, was promoted by the Municipality for designs for lamp columns, wall brackets, lanterns, governors, and lamp lighting appliances. Difficulties in executing the successful designs for columns and brackets led to their being modified by the Building Department. A modified form of Riter lantern was adopted for use on the columns, and a suspended lantern for the wall brackets. The suspended lamps, and lamps with more than one burner, are provided with a small flame, constantly alight, for lighting them; but the ordinary street lamps are lighted by means of a torch. Most of the burners are provided with Behl's governors, set for a consumption of 3.7 cubic feet per hour.

The service pipes from the street mains to consumers' premises are of wrought iron, except when they exceed 3 inches in diameter, when they are of cast iron. The wrought iron pipes are protected from rusting by a coat of asphalt; but the cast iron ones are uncoated. Cocks are placed outside the houses on all service pipes of 2 inches diameter and upwards. The Municipality, after exhaustive investigation, decided to use wet gas meters, except in some special cases. The question of connecting the meters when the supply of gas was taken over by the Municipality was a most important one, and was dealt with by a special sub-committee. Certain rules were made for meeting the various cases likely to arise. But ultimately the chief difficulties were set aside by an agreement being made whereby the meters of the Imperial Continental Gas Association were to become the property of the Municipality at the expiration of the Association contract. It thus became necessary merely to connect up the Municipality's service pipe with tne meter at some point in the existing service pipe between the meter and the tap which shuts off the supply. Where such a tap existed outside the building, the service pipe from the Municipal mains was connected to the existing service between the tap and the meter; and a tap was inserted on the new service pipe alongside the existing tap. A casing was placed over the two taps, so that the change could be effected at once from the pavement. There were 5,200 connections made in this manner. In the majority of cases, however, there was only a short length of pipe between the tap and the meter; and in these cases the new service pipe had to be connected here and provided with a tap. Special precautions were taken to prevent the consumer opening this tap until the supply of gas was begun by the Municipality. The number of connections made in this manner was 27,100. The length of the service pipes put in amounted to about 234 miles.

A Challenge of Scientific Axioms.

[By J. C. Bayles, M.E., Ph D., in the *Metal Worker*.]

A few days ago I fell in with a little book which gave me more entertainment in an hour than I usually manage to extract from reading in a month. It is not a humorous book, at least the author did not intend it should be so regarded. He is in deadly earnest throughout, and with the implacable zeal of the iconoclast he attacks certain "Errors in Science Teaching." This, by the way, is the title of the little book in question, and the author is Prof C. Stuart Gager, of the State Normal College, Albany, N. Y.

Professor Gager's quarrel is not with the facts which are reasonably well established from observed phenomena, but with certain slipshod forms of expression embodied in most technical literature and all technical teaching, and which, failing to state the truth accurately, are supposed to be conducive to disjointed and inconclusive thinking. The first of the fallacies which the author attacks is that concealed in the familiar proposition, hot air tends to rise.

Professor Gager shows very clearly that it has no such tendency. This will make a good many readers of the *Metal Worker* "sit up" and rub their eyes. The trouble with this form of words, which is one of the heritages of the present from the past, is not with the phenomenon that hot air does rise when free to move, but that it has a "tendency" to do so.

To speak by the card, it has no such tendency, any more than has a hot flat iron or a hot tamale. Hot air, as well as cold, is constantly acted on by gravity, and gravity imparts to it a tendency to move toward the center of the earth. Heating air does not correct this tendency or create a tendency to set gravity at defiance. What happens to cause air to circulate by the rising of that which is relatively warm and the falling of that which is relatively cold is described by Professor Gager as follows:

Suppose that the air of a room is at a given temperature. It is, then, other things being equal, of equal density throughout; but if a given cubic foot is heated it expands and occupies more than a cubic foot of space. Its weight remains the same, but the weight of the air it displaces after it is heated is greater than that of the air it displaced before it was heated; hence the buoyant force is greater than the weight of the heated air, which, in consequence, rises.

If one was disposed to be hypercritical he might ask why, as air is a measurably homogeneous gas, 1 cubic foot which chances to have acquired heat should retain its identity and displace another cubic foot

of air which happens to have remained cold? To press this question might be "to inquire too curiously." The author says:

Hot air, then, is not lighter than cold air. If, however, 1 cubic foot of (any old) air is heated and in expansion made to fill 2 cubic feet, each resultant cubic foot weighs only one-half the weight of the original cubic foot, because it contains only one-half as much air. The same amount of air, however, now occupying 2 cubic feet, weighs as much as it did before it was heated.

This is indisputably true, and would be interesting and significant if 1 cubic foot of air was different from another foot of air, and had a distinct and inextinguishable identity. But it hasn't. It leads us irresistibly to the conclusion that a cubic foot of warm air weighs (or may weigh, if hot enough) only half as much as a cubic foot of cold air. That it is acted on by gravity, and that in consequence of such action it tends downward instead of upward, is true enough, but so for that matter does a cork in water. The reason the immersed cork floats, while the cork in air lies quiescent as near the center of the earth as it can get, is because it is lighter than the water it displaces in the one instance, and heavier than the air it displaces in the other instance. Light and heavy are relative terms.

In splitting hairs as to the meaning of words, Professor Gager appears to have lost sight of the fact that too much refinement of one's technical vocabulary is apt to result in a confusion of ideas. As an abstract scientific proposition it is not true that hot air tends to rise. It is true, however, that in a body of air of unequal temperature the parts which are warmer, being lighter, volume for volume, than the parts which are cooler, do rise, not by virtue of what the old physicists called "specific levity," but because gravity, acting more powerfully on the denser air, draws it down and deposits it in strata under the warm air, which is thus uplifted and made to assume a relatively higher position.

Consequently, to say that warm air, which does rise relatively to colder air, which is more powerfully acted on by gravity, because more dense, has a "tendency to rise," is to state the fact correctly—within the usual limits of colloquial accuracy. Relatively in cold air, hot air rises. It does so in obedience to a natural law, which compels it to do so. What matter is compelled to do in obedience to natural law it tends to do. What matter tends to do habitually may, without a very violent stretch of the imagination, be said to represent its tendency. The phrase may not reflect all the shades of meaning which present themselves to the mind of one who is both a physicist and a purist; but it is a long way from admitting of proper classification among the "errors of science teaching." I am accordingly compelled to conclude that Professor Gager, in this instance, has found against the familiar phrase, "Hot air tends to rise," an indictment which will not stand, and which must be dismissed with costs—said costs having been incurred in the publication of his entertaining little book.

Another familiar formula which Professor Gager seeks to discredit by showing that it is fallacious and misleading is that heat expands and cold contracts.

The several pages of his unique book devoted to demolishing this familiar axiom are full of interest, but they lead to the conclusion that it would be perfectly satisfactory if recast as follows: With two known exceptions, masses of matter when heated increase in bulk for the reason that the molecular movement, becoming more energetic with each degree of absorbed heat, demands that the molecules have more room in which to oscillate. Hence the dimensions of such mass of heated matter become greater, and we observe the phenomenon popularly known as expansion. If, however, the temperature of the mass is lowered the attraction of cohesion tends to re-establish the molecular relation temporarily disturbed, and we observe the phenomenon of contraction erroneously attributed to cold, since the body shrinks.

This would be very good phrasing for the class room or the lecture platform; but life is short, and let us see whether any essential error is embodied in the familiar formula, "Heat expands and cold contracts." Let us suppose that 60° F. is our datum line. It is probably as near to average normal temperature as we can get. Indoors we have a stove, out of doors the thermometer records zero. The object of our experiment is a rod of iron. If we take this to the stove and leave it where it will become hot, we may, if we know how and our instruments are delicate enough, establish the fact that with each degree of heat taken up by the iron above 60° F. the rod expands sufficiently to add 0.00006 to its length. If, on the other hand, we take the rod at 60° F. and lay it on the window sill, we may, by the same methods, observe that it contracts sufficiently to shorten it as much for each degree of heat lost as it lengthened with each degree of heat added.

Half the proposition is certainly true; the other half is in error only in the assumption that cold is a force, the antithesis of heat, whereas it is simply a phenomenon resulting from the absence of heat. Strictly speaking, cold does not contract—it is the attraction of cohesion which does that; but the student might very well reason as follows:

"Cold is a term employed to indicate the absence of sensible heat; *ergo*, the absence of heat is cold. Matter expands by reason of the presence of heat; in the absence of heat it contracts again. Hence heat expands and the absence of heat permits contraction. To save time I will express this phenomena in the simplest and most intelligible language I can employ—viz., heat expands and cold contracts. If the Professor should quarrel with my terminology, I will tell him that I know perfectly well that cold is not a force and doesn't contract things, but that I really believe I can employ my time to better advantage in learning phenomena than in lying awake nights wondering how to describe them in words of such precision that a hypercritical old pedagogue cannot find opportunity to correct them. When I become a teacher it will be time enough to subject every word employed to a qualitative and quantitative analysis."

Still another popular scientific error upon which Professor Gager jumps—I was about to say with all four feet, but, as he probably has only two feet, I might thereby lay myself open to correction—is the statement that water seeks its own level.

This sentiment, Professor Gager insists, has no meaning, since water does not seek anything. Technically, this is correct. The habit of indulging in or prosecuting searches is not one of the attributes of water. It flows, percolates, permeates, evaporates and does an infinite variety of things, but it does not search. Perhaps this is due to the fact that it does not know just what it wants, and consequently cannot look for it.

Professor Gager's thesis is that water has no "level" of "its own," which it continuously seeks. It is not difficult to establish this thesis. If one makes a man of straw he may buffet him, abuse him and end up by kicking the stuffing out of him, and be quite sure he will meet no formidable resistance and suffer no reprisals. A translation of the objectionable formula that water seeks its level would be that water in vessels between which communication exists will, if unrestricted by adverse and disturbing influences, ultimately stand at a common level in both. In this form, it is unobjectionable. Professor Gager interposes the objection, however, that if a number of stand pipes are erected perpendicular to the horizontal outflow pipe of a reservoir in which water stands at the level of, say, X, the water will not rise in these stand pipes to the level X, but that the levels it will attain in the stand pipes will correspond to a line drawn from X, the level of water in the reservoir, to O, the orifice of the discharge pipe—presuming, of course, that the orifice is open.

I presume this is so, but inasmuch as the water is diverted from its natural tendency by reason of the fact that what it might like to do is incompatible with what it must do under the circumstances described, it is not exactly clear to me that the phenomenon described establishes the fact that the "tendency" to rise in the stand pipes to the level of the reservoir does not exist. I have frequently found my own tendency thwarted by adverse circumstances, and have been unable to do what I wanted to do by reason of the fact that I could not do it. This may be the case with the water. If the orifice of the discharge pipe is closed the rapidity with which the water will rise in the stand pipes to the X level of the water in the reservoir will be found extremely suggestive of a previously restrained tendency on the part of water to do this very thing.

To say that "water seeks its own level" is a loose way of expressing a perfectly well understood phenomenon, but it is about as brief and convenient a form of words as could well be found. It implies that part of a body of water has been temporarily elevated or depressed above or below the level of the rest of the same body, and that, if free to move, it will return to its place as part of such larger body and the common level of the surface of such body will be as promptly as possible restored. This statement of the matter is indisputably true. It is also true, as exemplified in the hydrostatic paradox, which bothered the early philosophers from Archimedes down, that if two bodies of water, one as large as the Atlantic and the other inclosed in the bore of a pipe stem, are connected, the water will stand in one exactly as high as in the other.

The more we study Professor Gager's little book the more we wonder why he wrote it. However, if others have as much pleasure from it as I have had, it will not have been written in vain.

Uniformity of Analysis in the Portland Cement Industry.[1]

At a meeting of the New York Section of the Society of Chemical Industry, held at the Chemists' Club on the evening of December 20, the Sub-Committee of the Section on "Uniformity in the Analysis of Materials Pertaining to the Portland Cement Industry," presented its report through the Chairman, Mr. Clifford Richardson, the other members being Prof. S. B. Newberry and Mr. H. A. Schaffer.

This committee was organized in April of this year to endeavor to discover the cause of the great lack of uniformity in the results obtained by different chemists engaged in this line of work. For this purpose a circular was widely distributed asking for co-operation, and favorable responses were received from over 30 chemists who agreed to undertake the analysis, with a description of the methods employed, of samples of a raw rock mixture from the Lehigh Valley and a finished Portland cement. Results were returned by eighteen. The committee was fortunate in securing, through the Director of the U. S. Geological Survey, the co-operation of Mr. W. F. Hillebrand, who not only made a most careful and thorough analysis of the materials, but was good enough to review the results which were reported, criticize the methods, point out the causes of lack of uniformity and agreement in the results and also made some valuable suggestions as to a method proposed by the committee.

The results reported by the 18 chemists showed great discrepancies, the variations in the analyses being as iollows:

	Raw Rock Mixture. Per Cent.	Finished Cement. Per Cent.
Silica	15.75 to 13.56	21.56 to 19.18
Average	2.19	2.38
Alumina and Iron	8.50 to 6.70	11.36 to 9.32
Average	1.80	2.04
Iron	2.73 to 1.26	3.76 to 2.30
Average	1.47	1.46
Lime	41.92 to 39.79	64.30 to 62.01
Average	2.13	2.29
Magnesia	2.14 to 1.10	3.13 to 2.52
Average	1.04	.61

The committee, in the light of the information conveyed by these results and methods, and guided by the advice of Mr. Hillebrand, has formulated a method of analysis which is described as follows:

Solution.—One-half gram of the finely powdered substance is to be weighed out and, if a limestone or unburned mixture, strongly ignited in a platinum crucible over the blast for 15 minutes. It is then transferred to an evaporating dish, preferably of platinum for the sake of celerity in evaporation, covered with a watch glass and 10 c.c. of HCl diluted with about 50 c.c. of water added. Digestion on the water bath is allowed to go on for about 15 minutes when the substance should be entirely decomposed. (If anything remains undecomposed it should be separated, fused with a little Na_2CO_3, dissolved and added to the original solution.) The cover glass is then removed, washed and the solution evaporated to dryness, as far as this may be possible on the bath.

Silica.—The residue, without further heating, is treated at first with 5 to 10 c.c. of strong HCl and then with as much water as the dish will comfortably hold. The cover is then replaced and digestion allowed to go on for 10 minutes on the bath, after which the solution is filtered and the separated silica washed thoroughly with hot water. The filtrate is again evaporated to dryness, the residue, without further heating, taken up with acid and water, and the small amount of silica it contains separated on another filter paper. The papers containing the residue are transferred wet to a weighed platinum crucible, dried, ignited, first over a Bunsen burner until the carbon of the filter was completely consumed, and finally over the blast for 30 minutes and checked by a further blasting of 10 minutes or to constant weight. The silica, if great accuracy is desired, is treated in the crucible with about 10 c.c. of HFl and 4 drops of H_2SO_4 and evaporated over a low flame to complete dryness. The small residue is washed, finally blasted, cooled and weighed. The difference between this weight and the weight previously obtained gives the amount of silica. (For ordinary control work in the plant laboratory this correction may, perhaps, be neglected; the double evaporation never.)

Aluminum and Iron Oxides.—The filtrate, about 250 c.c., from the second evaporation for SiO_2, is made alkaline with NH_4OH and boiled to expel excess NH_3, or until there is but a faint odor of it, and the precipitated iron and aluminum hydrates, after settling, are washed once by decantation and slightly on the filter. Setting aside the filtrate the precipitate is dissolved in hot dilute HCl, the solution passing into the beaker in which the precipitation was made. The aluminum and iron are then reprecipitated by NH_4OH. The second precipitate is collected and washed on the same filter used in the first instance. The filter paper, with the precipitate, is then placed in a weighed platinum crucible, the paper burned off and the precipitate ignited and finally blasted ten minutes, with care to prevent reduction, cooled and weighed as $Al_2O_3+Fe_2O_3$. (This precipitate contains TiO_2, P_2O_5, MnO.)

Iron Oxide.—The combined iron and aluminum oxides are fused in a platinum crucible at a very low temperature with about 10 grams of $KHSO_4$, the melt taken up with hot water and 25 c. c. of dilute H_2SO_4. The clear solution is then digested on the steam bath for about ten minutes and, if accuracy is desired, the small amount of silica is filtered out, weighed and corrected by $HFl+H_2SO_4$. The filtrate is reduced by hydrogen sulphide, boiling out the excess afterward while passing CO_2 through the flask, and titrated with permanganate. (In this way only is the influence of titanium to be avoided and a correct result obtained for iron.)

Lime.—To the combined filtrate from the $Al_2O_3+Fe_2O_3$ precipitate, a few drops of NH_4OH were added and the solution brought to boiling. To the boiling solution 10 c.c. of a saturated solution of ammon. oxalate is added and the boiling continued until the precipitated CaC_2O_4 assumes a well defined granular form. It is allowed to stand for twenty minutes or until the precipitate has settled and then filtered. The precipitate and filter are placed wet in a platinum crucible, and the paper burned off over a small flame of a Bunsen burner. It is then ignited, redissolved in HCl and the solution made up to about 100 c.c. with water. Ammonia is added in slight excess and the liquid is boiled. The small amount of Al_2O_3 which is separated is filtered out, weighed and the amount added to that found in the first determination, when great accuracy is desired. The lime is then reprecipitated by ammonium oxalate, allowed to stand until settled, washed in a moderate amount of water, weighed as oxide by ignition and blasting to constant weight, or determined with standard permanganate. The accuracy of this method admits of criticism, but its convenience and rapidity demand its insertion.

Magnesium Oxide.—The combined filtrates from the calcium precipitates are acidified with HCl and concentrated on the steam bath to about 150 c.c., 30 c.c. of a saturated solution of $Na(NH_4)HPO_4$ are added, and the solution transferred to a beaker and boiled for several minutes. It is then removed from the flame and cooled by placing the beaker in ice water. After cooling NH_4OH is added drop by drop with constant stirring until the crystalline ammon-magnesia ortho-phosphate begins to form and then in slight excess, the stirring being continued for several minutes. It is then set aside for several hours in a cool atmosphere and filtered. The precipitate is re-dissolved in hot dilute HCl, the solution made up to about 100 c.c., 2 c.c. of a saturated solution of $Na(NH_4)HPO_4$ added, and ammonia drop by drop, with constant stirring until the precipitate is again formed as described. It is then allowed to stand for about two hours, when it is filtered on paper or a Gooch crucible, cooled and weighed as $Mg_2P_2O_7$.

Potassium and Sodium Oxides.—For the determination of the alkalies, the well known method of Prof. L. Lawrence Smith is to be followed, either with or without the addition of $CaCO_3$ with the NH_4Cl.

Sulphur Trioxide.—One gram of the cement is dissolved in 15 c.c. of HCl, filtered and the residue washed thoroughly. (Evaporation to dryness is unnecessary, vide Hillebrand.) The solution is made up to 250 c.c. in a beaker and boiled. To the boiling solution 10 c.c. of a saturated solution of $BaCl_2$ is added slowly, drop by drop, from a pipette, and the boiling continued until the precipitate is well formed. It is then set aside over night, filtered, ignited and weighed as $BaSO_4$.

Total Sulphur.—One gram of material is weighed out in a large platinum crucible and fused with Na_2CO_3 and a little KNO_3, being careful to avoid contamination from sulphur in the gases from the source of heat. The melt is treated in the crucible with boiling water and the liquid poured into a tall narrow beaker and more hot water added until the mass is all dissolved. The solution is then filtered. The filtrate contained in a No. 4 beaker is to be acidulated with HCl and made up to about 250 c.c. with distilled water, boiled, the sulphur precipitated as $BaSO_4$ and allowed to stand over night.

Loss on Ignition.—Half a gram of the cement is to be weighed out in a platinum crucible and blasted 15 minutes. The loss by weight, which is checked by a second blasting of 5 minutes, is loss on ignition.

The committee earnestly requests all chemists to give this method a trial, and especially those who still have the samples distributed previously, and to report their results to the chairman with criticisms of it and suggestions for its modification.

1. *Engineering Record.*

High Pressure Gas Lighting.

[A paper read by MR. W. H. CASMEY at a meeting of the Manchester (England) and District Junior Gas Association.]

The subject before us this evening may, I think, be safely called the acme of artificial illumination; but its value will be better understood by taking a rapid survey of the lighting of the past, and comparing it with the present high standard of efficiency. Far back in the ages we read of oil lamps being used, and proof of this we find in many different quarters where old ruins have been brought to the surface. The Ancients, however, never appear to have employed anything but tallow or oils for their illumination, although in many cases Nature made every effort to call their attention to the buried sunshine by causing the gas from coal to escape on the earth's surface; and this accidentally being fired was only thought of as a natural phenomenon. Towards the close of the Eighteenth Century, however, William Murdoch brought his mind to bear on the subject, with the result that, after various experiments, he succeeded in giving to the world one of the greatest blessings known to mankind—a power which makes work possible during the night as well as the day, practically the opening of a page of the past which enables mankind to live in the sunshine which was stored up for him by the Creator millions of years ago.

I have had a wide experience of the various industries in the United Kingdom; but there is none so fascinating as that of the gas engineer. He appears to me as a magician. The coal is brought to him from the mine; and, to look at, it appears lifeless—merely pieces of black rock. Under his skill, however, the light and warmth of the sun of ages ago are given out for man's benefit. The perfume and colors of the flowers of the past are also brought back to life; the natural oils are collected from that dull, black mass; and the mechanical power of the sun is brought again to life in our gas engines. The picture can be carried still further. The gas engine drives the dynamo; and wires are carried to the various parts of a large works, and small motors driven for all kinds of industrial purposes. In other words, the rays of the sun before the time of man are now utilized for his benefit. We can even go further still, and find that the waste from gas works is the best fertilizer of the earth, and crops under treatment with it yield greater returns than by any other method.

As one who knows some little of the practical side of engineering, I would say that the gas engineer holds a unique position among men. If the miliions of tons of coal we waste yearly in raising steam and attempting to warm our homes were passed into the gas works, and gas instead of the raw fuel used for warming or steam raising purposes when necessary, the atmosphere of the large towns would be much clearer than at present, and more than double the value would be obtained from the fuel used. From Murdoch introducing gas lighting in 1798, many wonderful inventions have been introduced for purifying, etc. These are fully described by Mr. Newbigging, in his excellent "Handbook for Gas Engineers and Managers."

For the first half century, the gas engineer had little or no competition. Then we find electricity brought forward; and the battle for light went on for some considerable time, when electricity appeared to be firmly established as the light of the future. Many gas engineers seemed to lose heart, and were inclined to remain passive; but others, with more fight in them, continued to make effort by improving their manufacturing plant and enriching the gas with various substances. In 1887, the Welsbach burner and mantle were introduced; the spirits of the gas world went up; and the battle "Gas vs. Electricity" again commenced. Dynamos and lamps were improved so that more light was secured for a given horse power.

About four or five years ago, several attempts were made to produce apparatus for compressing gas taken from the street mains, and serve this to special burners and mantles. Water pressure was the means generally adopted for the purpose; but owing to defective construction, so much water was used to work the compressors that, although better lighting was secured, it was at such an enormous expense that the high pressure system would, no doubt, have been discarded, but for the invention of a suitable compressor by Mr. Jamrs Keith, the Chairman of the James Keith & Blackman Company, Limited. Since that time, gas has taken the premier position for lighting large open spaces, and also for lighting works of various kinds. One of Keith's smallest compressors we have here for inspection, and from which the burner is being supplied. Here we have an opportunity of comparing the ordinary gas jet, the incandescent and the high pressure system; the illuminating power per cubic foot of gas being respectively 5, 15 and 33 candles.

The Keith compressor is worked from either the ordinary street pressure or from a cistern, is automatic in operation, acts as a governor as well as a compressor, uses very little water (about 1½ gallons for every 10 cubic feet of gas compressed), and has the approval of the water companies. In operation it is silent, has practically no visible movement, and is devoid of friction in the air and gas pump portions, which require no packing leathers or oiling. It can be placed in almost any position with safety, and gives an unvarying pressure without any pulsation. The apparatus has been examined by many competent engineers, and all agree that it is the most perfect and economical of its kind. For high pressure lighting or compressing air, for the better combustion of acetylene gas, or any other purpose, the apparatus has no equal; and being so economical in consumption of water, this need not be taken into account. At 14 cents per 1,000 gallons, over 30,000-candle power per hour will cost about 2 cents.

The compressor consists of a reciprocating water motor acting directly on a practically frictionless double acting pump, which takes the gas from the main, and forces it into a small holder weighted to the desired pressure, which, in the present case, is about 8 inches. This holder is arranged so as to control the water supply to the motor, shutting it off as it rises, and opening the supply as it falls. The apparatus before us will compress as a maximum 150 cubic feet of gas per hour, equal to about 5,000-candle power.

In all other machines for the same purpose, the principal trouble has been experienced with the pump portion; the work done in overcoming the friction of the piston and glands of which amounted to more than the actual work performed in raising the pressure of the gas, even when kept well lubricated and fairly slack, to say nothing of the trouble arising after being in use for a time, owing to leakage of gas at the glands and piston and clogging with dirty oil. The above troubles are overcome in the Keith apparatus, by using, instead of a fitted and packed piston, a small holder or bell working in a deep annular water seal. This gives at once an absolutely tight piston, with no friction, and requiring no lubrication or cleaning. The top and underneath portions of the pumping bell are each connected to suitable inlet and discharge valves, so arranged as to make it double acting. It is, therefore, apparent to the practical mind that, by doing away with the friction of the piston and gland of the pump, the power required to do the work of raising the pressure is reduced to a minimum. In cases of works where it would be inconvenient to adopt the water motor, the apparatus can, by a slight modification, be operated from any existing source of power, with the same satisfactory results.

The Keith compressor is used by several gas lighting companies, including the Intensified Gas Light Company, the Welsbach Incandescent Gas Light Company, and the Atmospheric Gas Company; and the members will all have an opportunity of seeing it in operation on the Manchester Infirmary Esplanade to-night, where it has been installed for about 6 months.

In Manchester and district alone, during the last few months, our system of high pressure gas lighting has been applied by about a dozen firms; the total amount of light being nearly 300,000-candle power. In one case, Messrs. Crossley Bros., the well-known gas engine makers, have 18 three-cluster lights; and these replace 40 arc lamps and 78 ordinary gas jets. Messrs. Crossley Bros. are well satisfied with the installation, and have paid us the greatest possible compliment by giving a repeat order. Messrs. Royles, engineers, of Irlam, have also installed the light throughout their new works, 5 acres in extent, with the most satisfactory results; and only a day or two ago we received the order for 2 large compressors for lighting the Bury Market. I merely give this information to enable you, who are studying the interests of the community, to judge in what direction the leading firms are looking for the light of the future.

A most important adjunct of a good high pressure lighting installation is the Keith burner. Like the compressor, it has two splendid qualities—simplicity and efficiency; and it is quite free from the musical attainments many other burners possess. Personally, I have tried in every way to make the burner whistle, but have failed; so that there is no danger, when it is used, of the objectionable noise so often complained of in other types.

Now a word or two anent the possibilities of high pressure gas in other directions than lighting. I have, during the past few weeks, made several experiments in applying it for heating pressing irons for clothiers. With the ordinary box iron heated by means of a Bunsen burner, the time taken to heat the iron was 30 minutes. When a small nipple was fitted with a Bunsen, and high pressure gas used, the iron was heated in 8 minutes. The solid irons were then treated, and the time reduced from 30 minutes to 7 minutes. Wishing to have something still more reliable, I had the compressed gas applied to a large stove, using nipples of very small bore, about $\frac{1}{64}$th inch in diameter.

In the stove a vessel containing water was placed, and arrangements made for taking the temperature of the water every 5 minutes. The total results were that in 17½ minutes the water was at 210°. The ordinary Bunsen was then applied; and the time taken to heat up the same volume of water to 210° was 65 minutes.

Further experiments were made with pressing irons where the Bunsen gets its air supply from a small pressure fan. The Bunsen often fires back; and the result is that the irons soon become choked with soot. Dispensing, however, with the pressure fan, and only using the high pressure gas, there is not the slightest trouble. The irons are kept at a constant temperature the day through; and at the close of the day the insides of the boxes are quite clean. From this we find that the compressor can do away with the pressure fan, as used very largely in our laundries and clothing factories, and in its place supply, without noise, a cheaper and more efficient apparatus, and one that can be applied where there is no other power than water pressure.

The possibilities of high pressure gas are beyond conception. We may, as before implied, find that the gas works are the sources from which both light, warmth, and cooking for our large towns are drawn. The pressure may remain as at present in the mains, but compressors be used where more light or heat is required.

In conclusion, is it not possible to send gas into the mains of a poorer quality—say, instead of 19 candles, 14 or 15 candles? This would mean an increase in the amount of gas per ton of coal of nearly 20 per cent.; and to increase the power of illumination, the compressor could be used. It has been proved now many times over that high pressure gas has come to stay. No other light so nearly approaches daylight; and for dye works and print works, it is invaluable, as the colors are given as true as on the brightest day.

You gas engineers and managers have a duty to perform. It is in your power to give, by means of high pressure gas, both a cheaper and more efficient light. You can supply power, both to cook and warm, for the thousands of homes in our large towns; and, by so doing, you bestow one of the greatest blessings on mankind—a clear atmosphere. For when the domestic chimney ceases to pour out its constant streams of smoke, fogs will be things of the past.

Discussion.

Mr. Chandley (Warrington) said no mention was made by the author in his paper of the amount of pressure it was advisable to use—whether it was 8 inches, which he (Mr. Chandley) believed was the usual pressure, or whether 18 inches would not be better; and if not, why not. With regard to the heating of irons and gas stoves referred to in the paper, he scarcely agreed that high pressure gas would heat more quickly than low pressure, *pro ratâ*. The higher pressure did not, in his opinion, increase the calorific value of the gas. To obtain an accurate comparison, they would have to know the consumption of gas in each case to do the same amount of heating in the given time. With respect to the suggestion that low quality gas might be passed through the mains, and the pressure raised so as to increase the heating power of it, he did not see, as he said before, how the greater pressure would mean increased calorific value, as the heating power was almost proportionate to the illuminating power. As to the statement that with the incandescent light, the color of materials, etc., was practically the same as in daylight, he might say that, so far as he knew, the high pressure gas, like the ordinary incandescent system, always imparted to things a green or yellow effect.

Mr. Casmey remarked that the general pressure used was 8 inches; the reason for not going up to 18 inches, or even higher, being, he assumed, that up to the present the mantle makers had not been capable of producing a mantle to stand a higher pressure. The difference in lighting and heating power in the various systems of gas lighting turned on the proper mixture of gas and air so as to get the best consumption; and the reason he took it for getting a better light with the high pressure than with the ordinary incandescent system was that they had a better mixture of gas and air. The mixture was 5 to 1, against (say) 3½ or 4 to 1 in the ordinary incandescent light. With reference to color effects, according to the statements of those who had used high pressure gas light, it gave the nearest approach to the effect of daylight.

Mr. Mitchell asked whether it would not be better to have the light inclosed in a glass globe with prismatic faces, so as to split it up and diffuse it more, instead of having it concentrated.

Mr. Casmey said that in almost every case where the light had been installed special lanterns or lamps were used for the purpose. There were many reasons why it should have a glass round it, particularly (say) in an engineering shop, where the glass would prevent chips coming in contact with the mantle. He had noticed, with a cluster of 3 burners, that the light was more agreeable to the senses when used in a lantern than without one.

Mr. Butterworth asked how they overcame the variations of pressure.

Mr. Casmey said they had a bigger supply going into the compressor than they were taking out; and there was not that fluctuation which might be naturally expected. They had always more pressure than the light could take. Any fall in the reserve was so slight as to be scarcely noticeable.

Mr. F. West asked what was the cost for upkeep of the burner, for mantles, etc. He thought the intensified gas system had come rather as a "staggerer" to the electric light people, and might have the effect of making some of the corporations think twice before introducing electric lighting. The public wanted a good light. Up till lately, the electric arc held the field; but it seemed to him that intensified gas light would supersede it. He understood that the incandescent gas light pierced farther in a fog than the electric arc, and that the ordinary flat flame burner was better than anything in this respect, although it had not the illuminating power of the intensified light.

Mr. Casmey said that at the Glasgow Exhibition the life of the mantles was from 9 to 11 weeks. At the time of their visit to the Manchester establishment, 6 weeks ago, he put some new burners on the lantern over the door. The mantles were still on, and they had been burning every night.

Mr. Garlick said he was acquainted with the installation at Messrs. Royle's works at Irlam, where by means of Keith's compressor, they were able to get adequate illumination, notwithstanding that there was a great difference in level between the gas works and that particular locality, and that, apart from the compressor, there was very little pressure. He was under the impression he had seen it stated that they could get a better effect from gas of low illuminating power on incandescent lights than from gas of high candle power. He thought Mr. Chandley was wrong in saying that the heating value of gas increased as the illuminating power.

Mr. Casmey observed that with the more general adoption of electric lighting for public buildings, schools, etc., their business in electric fans for the ventilation of such buildings had greatly increased. In places where gas was used, the electric light was installed, and this represented practically a sealed box, giving no ventilation whatever. Consequently, they had to put in electric fans to ventilate places which the gas had ventilated before. They knew that the air was charged with germs. Now, with a burner like the one he had been describing, they had a means of keeping up a constant circulation of air in the room. It fouled the air, he admitted; but the question was whether the fouling from the gas jet was more injurious than the breathing over and over again of the germs of disease which were present in a crowded room. He had had 20 years' experience in the heating and ventilating engineering business; and he certainly thought that, for health purposes, gas was a long way in advance of electricity, which was all very well in its place, and was for supplying power, and not for lighting.

Mr. Thorp asked what was the consumption of gas in the burners and stove used to raise the water up to 210° F. He said he had been trying some experiments with mixtures of gases; and they certainly indicated that increase of light and heat was a matter of more perfect combustion. It had been suggested that they might have 18 inches pressure. He found that Mr. Onslow, of Woolwich, was using about 54 inches, and hoped to obtain a light of about 2,000 candles, when he could get mantles to stand that pressure. Even from the mantles now available, he found it quite possible to get almost 2,000-candle power.

Mr. Casmey explained that the conditions with reference to the boiling of the water were that the same quantity of gas was used in both cases.

Mr. Mitchell asked whether crude water gas could be used with the system.

Mr. Casmey did not see why it should not be applicable.

Mr. Thorp—With a specially constructed burner.

Mr. Casmey said the nipple inside the burner must be of a different size for Manchester, Salford and London gas.

Mr. Mitchell thought the specific gravity of the gases in these places might account for it to some extent.

Mr. Barber observed that, while the specific gravity might have some effect, he thought the difference in candle power was the principal reason. As to the variation in calorific value, he found that, while increased illuminating power was accompanied by higher calorific value, the difference proportionately was not very great.

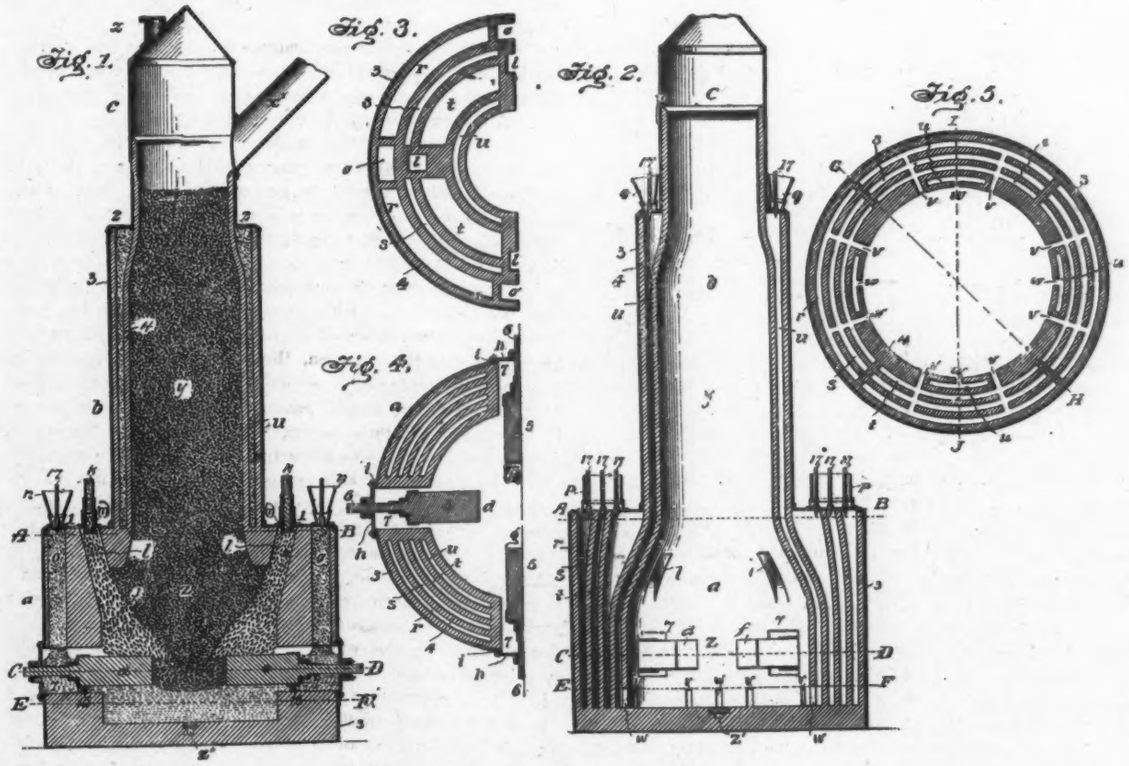
Mr. Smith said that, according to tests made at Bury, it appeared that

while with high illuminating power they obtained slightly better calorific results, the number of calories per candle was very much lower. There was a greater calorific value per candle with low grade than with high grade gas.

Mr. Ginman said he thought there was room for improvement in the burner used with the new system, so as to render it less noisy. The question of intensified gas lighting opened up a wider field than that involved in putting down compressors in various parts of a district; and he thought the time would come when the gas would be sent from the works at not less than 10 inches pressure.

Carbon Bisulphide in the Electric Furnace.

The *Electrical World and Engineer* reports that an electric furnace recently patented to Edward R. Taylor, of Penn Yan, N. Y., is of especial interest, not only as showing the details of a structure which has stood the test of prolonged commercial use, but as illustrating a fact, which is becoming yearly more and more apparent—that the field of the electric furnace is by no means to be restricted to the performance of reactions which require excessive temperatures, but that under well chosen conditions many chemical decompositions which lie within the temperature range of combustion furnaces may be more effectively and economically brought to pass by heat electrically developed within the reacting mass. The furnace presents a decided novelty, and has been in operation near Penn Yan for two years, producing carbon bisulphide by direct reaction between vapors of sulphur and carbon. It is understood that the output has reached 100,000 pounds per month, and that after two years of continuous operation the furnace remains in efficient working order.



Figs. 1-5.—Sections and Plans of Electric Furnace.

Figs. 1 and 2 of the accompanying drawings show the structure in vertical section, upon planes 45° apart, and indicated by the lines *GH* and *IJ* of Fig. 5. Figs. 3, 4 and 5 are horizontal sections on planes *AB*, *CD* and *EF*, respectively, of Fig. 1. The furnace is of the stack type, comprising a base, *a*, body, *b*, and dome, *c*. The carbon electrodes, *d*, *e*, *f*, *g*, supported by blocks 15, are arranged horizontally in pairs in the base of the structure, and above them are suitable ports for the introduction of the charge materials—in this case sulphur fed through hoppers *n* to passages *o*, and charcoal *z*, held in bulk in the main shaft *y*. The walls *b*, 4, are double in the intermediate or body portion, and into the interstitial space, *u*, sulphur is also fed by a hopper *q* to absorb and re-convey into the surface heat which would otherwise be lost by radiation. The lower section *a* is provided with a series of concentric walls, shown as five in number, thus forming four concentric passages, *r*, *s*, *t*, *u*, the innermost of which is continuous with the annular passage, *u*, of the body portion of the stack. All of these passages open at the bottom by ducts, *v*, *w*, into the hearth of the furnace, and through all of them sulphur is fed by hoppers, *p*. A sheet iron dome, *c*, continuous with the metal sheathing 3 of the furnace body, surmounts the structure, and is provided with a charging opening *x* and a pipe x^1 leading to a condenser for the bisulphide.

Upon the lower shoulder 1 of the furnace, and adjacent to the hoppers *n* for the introduction of sulphur, are four metal tubes, *k*, attached to but insulated from the sheathing 3. These conduits are situated respectively above the electrodes, and open into downwardly extending passages *l* within the masonry of the furnace base; through them conductive carbon *j* is fed upon and past the electrodes, and serves to protect them from excessive wear and also to close the circuit between them. It is in this bed of fragmentary carbon that the heat necessary for the reaction is developed.

The electrodes comprise a working end 5 and a metallic conductor 6; the electrode ports 7 are closed by removable plates, *h*, *i*, which also permit access to the interior of the furnace. At z^1 an outlet is shown through which the sulphur may be tapped. All hoppers are fitted with regulating plugs 17.

Complicated as the structure may appear, the operation is extremely simple. Sulphur is introduced into the base of the furnace to partially cover the electrode faces, and the several concentric passages between the walls are filled with the same material. Fragmentary coke or other conductive carbon is fed through the pipes *k* to cover and connect the electrodes, and the shaft is filled with the charge of charcoal. The circuit is now closed through the fragments *j*, whereupon the sulphur is vaporized and so reacts upon the charcoal, the resulting bisulphide escaping to the condensers. It will be seen that a double means of regulation is afforded, the current being governed either by the amount of conductive carbon introduced or by reducing the working surface of the electrodes by partially submerging them in the molten sulphur, and also that the waste heat of the furnace walls and of the electrode connections is utilized for liquefying the sulphur. In structure and function alike the furnace is distinctly novel, and its satisfactory operation during a long period bears witness to the care with which the details of construction have been worked out.

Motive Power from Blast Furnace Gases.

At an ordinary meeting of the English Institution of Civil Engineers, held on Tuesday, December 17, 1901, Mr. Charles Hawksley, President, in the chair, the paper read was "Motive power from Blast Furnace Gases," by Mr. Bryan Donkin, M. Inst. C.E.

The author considered, first, the importance of the discovery, made within the last few years, that power could be produced economically and effectively by utilizing the gases from blast furnaces to drive gas engines. As the annual production of iron from blast furnaces throughout the world was 40 million tons, this new application of motive power was capable of immense development. The gases given off from these furnaces during the process of smelting iron were practically the same as weak producer gas. Till within about half a century they had all been wasted. A part was next utilized under boilers to generate steam to drive the blowing engines, and part to heat the air blast; but after supplying these requirements a considerable surplus was available. Successful efforts had been made, first to use this surplus in gas engine cylinders to obtain power, and next to discard steam engines, boilers, and chimneys entirely, and utilize all the gas in this way.

The chemical constituents of the gases produced by smelting iron ore in blast furnaces varied according to the ore and fluxes used, the fuel burnt, and the temperature of the furnaces. They contained, however, on an average, about one-third by volume of combustible gases, chiefly CO, the remainder being inert CO_2 and N. The ratio of the CO_2 to the CO varied in every furnace. The higher it was—that was, the more CO_2 the gases contained—the better the efficiency of the furnace. More gas would be produced, but it had a poor heating value, and if the percentage of CO_2 was very high, the gas would not ignite in an engine. If, however, the ratio was low, and the percentage of CO high, the gas would have a relatively higher heating value. A table was given, showing the composition of the gases from six blast furnaces in England and on the Continent.

With the present method of utilizing these gases, about 10 per cent. was lost by leakage, 28 per cent. was applied to heat the air blast, 40 per cent. to the boiler, and 22 per cent. was wasted. If the latter percentage were utilized in gas engines, it would yield about 12½-horse power hours per ton of iron melted, while if all the gases were burnt in gas engine cylinders to produce power, about 28-horse power hours per ton of pig iron would be available after deducting the power required for compressing the air. When burnt under boilers, they gave a very poor heat efficiency, because the CO was of comparatively little value as fuel.

At least four times as much power could be obtained when the gases were treated in an engine cylinder, the method of utilizing them being more suitable. The store of power thus available had been calculated for English and Scotch furnaces at 2½ million-horse power per annum. The poorness of the gases was counteracted by diluting them with a smaller proportion of air than was required for richer gases. About one volume of air to one of blast furnace gases gave the best working mixture in an engine cylinder.

Other disadvantages were the variations in pressure and composition of these gases, their low heating value, and the dust with which they were charged. The first two difficulties were overcome by passing them into a holder before sending them to the engine cylinder, while the quantities produced were so large that these fluctuations were practically annulled. Their low heating value did not give rise to the difficulties at first anticipated, because they could be compressed to a higher degree, previous to ignition, than was permissible with other kinds of gas, when used to produce power. A high thermal efficiency was thus obtained, which compared favorably with that of other types of internal combustion engines. Compressions of between 7½ and 11 atmospheres were used, and the lower the heating value the higher was the compression required.

The dust with which the gases were charged was of two kinds—the heavy metallic dust deposited in the long and large gas mains, and the fine light dust which was partly removed by washing and cleaning, and partly blown out with the engine exhaust. At first elaborate and costly systems of washers and purifiers had been employed, but experience had shown them in most cases to be unnecessary, and the gases were seldom subjected to any further cleaning when burnt in engine cylinders than when used under boilers; the same pipes often served both systems. Sometimes they were washed with water, sometimes they were treated by dry processes. Such light dust as remained after cleaning was forced out with the exhaust by the action of the piston, and was not allowed to be deposited and clog the cylinder and valves. Among purifiers a new form of rotary washer had so far proved one of the most satisfactory. It was said to clean the gases effectually, and took up much less space and cost less than the usual array of pipes. The methods of cleaning the gases at Seraing in Belgium, Friedenshütte, Hörde and Donnersmarck in Germany, and Differdingen in Luxemburg, were described.

Two other difficulties were also considered, the production of gas engines large enough to utilize the vast stores of power available, and the desirability of driving the air blowing cylinders from them direct. A great impetus had been given to the construction of large motors by the discovery that blast furnace gases could be used to drive them. They were now made in sizes up to 1,000-horse power and 1,500-horse power, and still larger powers were in contemplation; while the difficulty of starting these large engines had been successfully overcome. To connect them direct to the blowing cylinders, which ran at a lower speed, was sometimes difficult. The subject was engaging the attention of scientific men and engineers, and success had already been partly, and doubtless in time would be fully, attained.

The author proceeded to sketch the history of this new development in engineering science. The pioneer of the movement, Mr. B. H. Thwaite, Assoc. M. Inst. C.E., had driven an engine with blast furnace gases in February, 1895, but the question had been simultaneously and independently treated at Seraing in Belgium, and at the Hörde Iron Works in Germany. Mr. Thwaite's experiments had been made at Wishaw, near Glasgow, on a 12-horse power engine, driving a dynamo. The heating value of the gas used had been 126 B.T.U. per cubic foot, consumption of gas 84 cubic feet per indicated horse power hour. The fuel used was "splint coal," and the gas was comparatively rich. Another small experimental engine had been successfully worked for some time at Frodingham, with gas having a heating value of 110 B.T.U. per cubic foot. A larger plant had been driven at Barrow.

At the iron works of the Société Cockerill at Seraing, three engines of 8-horse power, 200-horse power, and 650-horse power respectively had been tested, and most important work had been done. The first trials, made on an 8-horse power 4-cycle Simplex engine, had been sufficiently satisfactory to lead the Company to test a much larger engine. The 200-horse power motor of the same type, when experimented on in 1898, had shown a consumption of gas of 116 cubic feet per brake horse power hour, having a heating value of 110 B.T.U. per cubic foot. Thermal efficiency referred to brake horse power, 20 per cent. A still more important trial has been carried out in 1900 at Seraing on a 650-horse power Simplex engine, in the presence of many authorities. The consumption of gas was 101 cubic feet per brake horse power hour, and the thermal efficiency 26 per cent. per brake horse power. All the engines tested were single acting and single cylinder engines, a type to which the Seraing authorities gave the preference, in contradistinction to the multiple cylinder type advocated by the Deutz firm. The advantages and drawbacks of both classes of engine were contrasted by the author.

A third application of blast furnace gases to drive a gas motor had been made at Hörde in 1895. Here a new 2-cycle type, the Oechelhaeuser, which appeared to have a promising future before it for this class of work, had been tested. The engine had one long cylinder with two pistons and an air pump; for the latter the large blowing cylinder might be substituted. Several large plants were in course of construction, but the engine had not yet been tested officially. Another important trial, made at Differdingen on a 60-horse power 4-cycle engine, by Professor Meyer, in 1898, compared favorably with the Seraing experiments for care and completeness. The heating value of the gas was 105 B. T. U. per cubic foot, and the consumption about 95 cubic feet per brake horse power hour, the thermal efficiency being 25 per cent. per brake horse power. Trials had also been made by Köhler, in 1898, on a 40-horse power 4-cycle engine.

The author gave some account of the very rapid progress made in this class of work on the Continent. Many of the large firms in Germany and Belgium were now busily employed. The Gasmotoren-Fabrik Deutz had numerous orders for motors from 500-horse power to 1,000-horse power, while at Seraing an aggregate of 39,000-horse power had been bespoken. Messrs. Körting, of Hanover, had also supplied several engines, and the Deutsche-Kraftgas-Gesellschaft, the makers of the Oechelhaeuser, proposed to construct motors up to 1,500 and 2,000-horse power. England and Scotland seemed rather slow to utilize these gases. Well made gas engines now gave no trouble, were as easily driven as steam engines, and were much more economical.

A table of 9 tests of blast furnace gas engines was added; and in an addendum to the paper mention was made of what appeared at present to be the best way of getting rid of the troublesome light dust—viz., passing the gases successively through two centrifugal fans provided with water jets.

How to Prevent Fires in Dwellings.[1]

The fact that 46.24 per cent. of almost 110,000 pieces of property, which burned in 1900, were dwellings, and that at least 90 per cent. of these fires were from preventable causes, are truths which should awaken the attention of every householder and cause him to investigate his own premises. The fires in dwellings last year caused a property waste of over $23,000,000, and the insurance paid thereon was only about $13,000,000. It will be seen from this that the fire sufferers themselves bore too large a proportion of the loss, because too many of them were uninsured. There are no statistics of the loss of human life caused by fires in dwellings and tenements, but it is safe to say that in nearly 50,000 of these fires last year there were several hundred deaths. Every experienced fire fighter knows that it is the fires under discussion which produce the saddest stories of human misery and loss.

As has been said, the great majority of dwelling house fires result primarily from inexcusable carelessness. In 1900, the figures of which year are used because the complete fire statistics of that year are the latest obtainable, some 10,000 dwelling houses were burned from exposure to adjacent burning property. Such fires may, for the purposes of this article, be placed among the unavoidable ones. Nearly 11,000 fires resulted from defective flues. Now, defective flue fires are caused through faults in the structure or through neglect of chimneys. A large proportion start because, when fires are lighted when the cold weather sets in, no one takes the small amount of trouble involved in ascertaining whether the flue is in condition to withstand the effects of combustion.

Sometimes the combustible matter in the chimney will withstand for half a winter the effects of the heat, and then peculiar conditions of the draught and the right chemical combinations due to heat will start a flame. In the first place, very frequently chimney fires result from cheap, careless or "scamped" work in construction. The resident of a finished house will, if he is wise, see that his flue has been built properly. The use of his perceptive faculties, combined with common sense and a slight knowledge of easily understandable rules, will enable him to note defects, and the outlay of a small sum of money will sometime or other save him thousands of dollars, sharp annoyance and possibly his own life or the lives of those dear to him.

In regard to defective flues, note the following rules of construction:

All chimneys or flues should be built of good brick, preferably with double walls, or be lined with terra cotta or fireclay. There should be a solid foundation and the chimney should be allowed to settle firmly before being inclosed within a building. This point is important, because the chimney mass is liable to settle and draw away from that part supported by the roof timbers and leave a dangerous crack at an unfrequented spot. The quality of the mortar used should, of course, be of the best. The bricks should be carefully pointed inside as well as outside of the flue. This is safer than the usual method of plastering the inside, because atmospheric conditions and chemical action due to combustion have a tendency to disintegrate the plaster. Interstices in the flue allow sparks to escape or soot to accumulate.

When it is impossible to build the chimney from the ground it should rest on a solid timber foundation and have not less than 6 courses of brickwork at the base, cross-tied and bedded in good mortar. Never allow the use of flues built in unfrequented attics with stove pipes passing through the ceiling to them. Never allow the use of a flue built on the joilts above the ceiling, with stove pipes entering it vertically. The use of cement or vitrified pipes for flues is just as dangerous.

Woodwork contiguous to chimneys should be framed around them, leaving at least 2 inches of cleared space. Iron smokestacks through wooden roofs should be kept clear for a space of at least 1 foot, and the woodwork should be protected by an iron sleeve or jacket having a hood of metal. Hearths should be built on brick arches, sprung from the chimney breast to the stringer, leaving a space of at least 4 inches between the top of the arch and the hearth stone. The space should be filled with sand thoroughly tamped.

Stoves and stove pipes have in the last 17 years been responsible for over 12,500 fires in dwellings, which have burned many more pieces of property, caused much loss of human life and wasted millions of dollars worth of property. The most ordinary precautions will prevent the larger part of such fires. Protect all woodwork or lath and plaster finish, when within 18 inches of stoves or 10 inches of stove pipes, with plastering of bright tin or galvanized iron. Leave at least half an inch of open air space between the metal and the protected surface. Place brick platforms or iron pans on legs under each stove and extend them at least 2 feet in front of the ashpit.

1. *The Chronicle.*

Erect stove pipes so that the joints will overlap toward the stove; this will prevent the escape of sparks through imperfect joints. Clean them out frequently. Inspect them once in a while to see that corrosion, due to dampness or moisture, has not set in. Sometimes an apparently sound pipe will break under pressure of the fingers. When the pipe passes through the ceiling or floor, provide it with a metal collar or tube, with an inch of air space between the plates. Have the collar long enough to reach clear through. Do not forget that portion of the pipe which runs through the attic. Here the fire will start if you neglect a periodical inspection. Do not use wooden fireboards, and see that all unused pipe holes in chimneys are stopped with metal.

Now we come to matches. Next to defective flues they are the most pregnant cause of fires in dwellings; nearly 18,000 serious conflagrations have resulted from their careless use in 17 years. Keep them away from children. In a majority of cases the children's lives or limbs depend upon following this injunction. Use the so-called "safety" match, which ignites only on the box, if you are wise. Use metal receptacles for burned and unburned matches in any event. Have a place for them away from draperies and all inflammable material and keep them in their place.

All flexible or swinging gas jets, exposing woodwork or curtains, should really be made rigid and stationary. If you will not do this, inclose your light in a wire cage, if near curtains or tapestry. It was not long ago that the country was shocked over a horrible disaster whieh occurred in New York city. A swinging gas jet communicated its flame to a piece of tapestry one night and eight lives were sacrificed to inexcusable carelessness. If there is lath and plaster or woodwork not more than 18 inches above the flame of a gas jet, there is danger. Protect the inflammable part of the house with a metal or porcelain guard and leave at least an inch of open air space between the metal and the protected surface.

Nearly 3,000 fires were caused last year by explosions or accidents with lamps. A lamp accident or explosion usually means death or serious injury as well as fire. A little ordinary caution will prevent such accidents. The majority are due to the use of low grade oils which contain an undue quantity of naphtha, gasoline or other of the light products of petroleum. These products generate a highly explosive and inflammable gas under the heat of the lamp burner. Never turn the flame low. It overheats the metal dome over the wick and its metal connections. Do not allow the oil to run low in the fount. The gas generates more rapidly then.

It should be as unnecessary to warn against filling or trimming lamps while lighted as it would be to warn a swimmer not to drown. Remember that glass is more brittle than metal.

Oil stove accidents can be prevented by using the same precautions as those detailed for lamps. Instruct your servants carefully as to how and why such accidents occur and see that they follow your instructions.

Faulty construction is mainly the reason for fires caused by furnaces and heating apparatus. See that your furnace, whether hot air, steam or hot water, is placed on a solid foundation of brick or stone. Have stone, brick or metal not less than 36 inches wide in front of the ashpit.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

SENSIBLE progress is being made with the proposition to establish a gas works in Monroe, Wis. The concern is to be capitalized in $50,000, of which the sum of $35,000 has been subscribed.

MR. CHARLES F. DAY, of Revere, Mass., has been made superintendent of works of the Springfield (Mass.) Gas Light Company, vice Mr. Albert D. Merritt, resigned.

EX-JUDGE A. HEATON ROBERTSON has been elected to the vacancy in the Board of Directors of the New Haven (Conn.) Gas Light Company occasioned by the death of Mr. E. Hayes Trowbridge.

AT a special meeting of the Board of Directors of the New Haven (Conn.) Gas Light Company, held to prepare suitable minutes respecting the services of the late Mr. E. Hayes Trowbridge to the Company, the following resolution was adopted:

"*Resolved*, that the following minute be entered upon the records of the Board of Directors:

"Since the last meeting of this Board its members have learned with sorrow of the death of their associate, Mr. E. Hayes Trowbridge, which occurred on the 30th of November last.

"Mr. Trowbridge was a member of the Board since 1887, having been chosen on November 8th of that year to fill the vacancy caused by the death of Mr. John S. Beach.

"His interests in the community were many and varied, and to each of the responsible positions of trust which he filled he brought the same

high sense of honor and devotion to duty which contributed so much to the welfare of those enterprises with which he was connected.

"His loyalty to those interests and to his friends was one of the most conspicuous of his many admirable traits of character.

"In his relations to this Company he showed this same fidelity, and was at all times ready to give freely of his time and his counsel to further its interests.

"He took an active part in its management, and while on the one hand, realizing his accountability to its stockholders, on the other he keenly appreciated the responsibilities which the intimate connection of this Company with the life of the municipality entails.

"His personal relations with us, his associates, were intimate and cordial, and with the community we share the great loss which his death has brought.

"In token of our respect, we cause this minute to be entered upon the records of this Board, and direct that a copy be sent by the Secretary to the members of Mr. Trowbridge's family.—GARDINER MORSE, Sec'y.

THE owners of the Van Wert (O.) Gas, Electric Light and Power Company have cut the common stock from $100,000 to $50,000 and have increased the preferred stock from $50,000 to $100,000.

A CORRESPONDENT in Newark, N. J., informs us that construction work on the gas plant of the Boonton (N. J.) Gas Light and Improvement Company will be commenced forthwith. The engineering supervision has been given to Mr. C. C. Hartpence.

THE plant of the Dover, Rockaway and Port Oram Gas Company, of Dover, N. J., is rapidly approaching completion. In fact the Constructing Engineer, Captain W. H. White, says that gas making will be in order there by the 15th inst.

AT the annual meeting of the Gainesville (Tex.) Light and Fuel Company the following officers were elected: Directors, J. M. Lindsay, George Y. Bird, Sr., and W. C. Penfield, of Gainesville; Wm. H. Hopper, of Germantown, Pa.; and R. C. Johnston, of Lawrence, Kas.; President, J. M. Lindsay; Secretary and Treasurer, W. C. Penfield.

EARLY last month, the Court of Special Sessions of New York (Justices Wyatt, Hinsdale and McKeon sitting) rendered a decision against Charles W. Gray, convicting him of a violation of section 364 of the Penal Code, usually known as the "trademark law," in having sold incandescent gas mantles and lamps upon the representation that such lamps and mantles were Welsbach lamps and mantles. A fine of $50, or imprisonment for 25 days, was imposed upon Gray by the Court. The complainant in the case, Professor William S. Day, of Columbia University, stated that last October he entered the store of Gray on Broadway and asked for Welsbach lamps, and he further stated that Gray sold him lamps of another manufacturer instead of genuine Welsbach lamps. He afterwards endeavored to have the lamps replaced by genuine Welsbach lamps, and Gray replaced the lamps originally bought with defective and inferior Welsbach lamps. The Court in passing sentence called attention to the frauds upon the public which are perpetrated by dealers who are guilty of such practices, and warned the defendant that they would treat him much more severely if he again appeared before them. A number of similar frauds upon the public have been discovered, and it is said that numerous prosecutions will follow.

THE Directors of the Columbus (O.) Gas Light and Heating Company have declared a dividend of 3 per cent. on the common stock. It is payable on the 21st inst., to shareholders of record of the 7th inst.

AN important meeting of the Executive Committee of the Consolidated Gas Company, of Baltimore, Md., was held some days ago. It is understood that matters connected with the heretofore projected alliance with the United Electric Light and Power Company were discussed, and that substantial advances toward a traffic agreement between the two companies were made.

A CORRESPONDENT in Syracuse, N. Y., forwards a clipping from a recent issue of the *Post-Standard* of that city, which narrates that "In the proceedings growing out of the foreclosure of the first mortgage bonds brought by Mr. Manning C. Palmer, as Trustee, against the Syracuse Steam Heat and Power Company, Mr. George H. Bond has been appointed Receiver by Justice Andrews. The property was sold and bid in for the bondholders. It is claimed that the bondholders' committee proposes to reorganize the Company and engage in furnishing gas to the residents. It is also claimed that the amendment of the Company's franchise, heretofore sold to the Syracuse Gas Company, was also sold at the foreclosure sale, and now is the property of the bondholders' committee. This the Gas Company disputes, claiming that it bought and owns all the rights the Steam Heat and Power Company ever had to supply gas." Our correspondent adds, "Litigation is sure to result over the contention, but the thought of those who are conversant with the dispute, and who are not personally interested in the outcome, favors the stand taken by the Gas Company."

THE regular semi-annual dividend of 4 per cent. on the shares of the Hartford (Conn.) City Gas Light Company was voted by the Directors. It has been payable since the 2d inst. The Company's trading shows an increase of 12½ per cent. over that for 1900.

SINCE the first of the month, under the terms of the franchise by means of which the Equitable Gas Company supplies gas to the residents of Memphis, Tenn., the selling rates have been adjusted on the following basis: For an illuminating supply, $1.35 per 1,000; on fuel account, $1.10.

IN the reorganization of the Auburn (N. Y.) Gas Light Company (hereafter to be known as the Auburn Gas Company) the following officers were elected: Directors, E. H. Palmer, Irving Rouse, F. Yeoman, Chas. D. Robinson, Geo. B. Longstreet, D. M. Dunning and H. K. Seybolt; President, E. H. Palmer; Vice-President, Irving Rouse; Treasurer, Chas. D. Robinson; Secretary, George B. Longstreet. It gives us great pleasure to add that Mr. David M. Dunning will remain with the Company, acting in the capacity of General Manager thereto.

A VERY pleasant surprise was experienced by the employees of the Springfield (Mass.) Gas Light Company when, during Christmas week, they were summoned before the Manager, Mr. F. de V. Thompson and presented by him on behalf of the Company with gold pieces ranging in value from $2.50 to $10—the gifts were graded according to the terms of service of the recipients with the Company. The disbursement on Santa Claus account was not far from $500.

LAST week we noted that the Kerlin Bros., representing the Consolidated Gas Company, of Toledo, O., had been granted the right to construct and operate a gas works in Delphos, O. The working or ruling terms of the ordinance under which they may operate the plant are appended:

"Sec. 1. Be it ordained by the Council of the Village of Delphos that companies furnishing artificial gas to the Village of Delphos may charge therefor, when gas is furnished for illuminating purposes, not to exceed $1.35 cents per 1,000 cubic feet, and when such gas is furnished for fuel purposes such company may charge not to exceed $1.10 per 1,000 cubic feet. The rate hereby fixed shall be effective from the 1st of April, 1902, and for a period of 10 years thereafter; provided that when bills for gas shall be paid at the office of such company in the Village of Delphos within 10 days after the expiration of the month during which the gas was consumed, such company shall make a deduction from the rate above fixed of 10 cents per 1,000 cubic feet. Whenever gas is used by any one consumer for both illuminating and fuel purposes, such company may, at its option, require said consumer to have said gas measured through separate meters under such rules as it may prescribe.

"Sec. 2. No charge shall be made for artificial gas furnished for illuminating purposes that is not equal in quality to that now prescribed by the laws of the State of Ohio.

"Sec. 3. Every company furnishing gas under this ordinance shall comply with Section 3,561 of the Revised Statutes of Ohio. Whenever the amount of gas consumed in any one month by any consumer is less than 300 cubic feet, said company shall be entitled to make a charge in addition to the rate herein provided for of 25 cents per month as a service charge for maintaining connections and service with said consumer."

MR. EMIL G. SCHMIDT, Secretary and General Manager of the Sandusky (O.) Gas and Electric Company, writing to the JOURNAL under date of December 30th, says:

To the Editors AMERICAN GAS LIGHT JOURNAL: In the issue of the JOURNAL for December 30th I notice that you state that I had resigned my position as General Manager of the Sandusky Gas and Electric Company on account of politics. From this I assume that you have seen some of the absurd articles published by our daily local papers. As those articles were entirely without foundation, and an injustice not only to myself but to the Everett-Moore syndicate, of Cleveland, who are the present owners of the plant, I wish to correct the same. My relations with the Everett-Moore syndicate have been and are the pleasantest, and they had promised me the management of a number of their leased properties, but I declined the same, as I had received such a flattering offer from a manufacturing concern in this city that I could not afford to accept the syndicate proposition from a financial standpoint. I shall probably remain with this Company for the next 2 months, to complete some improvements that I had planned.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

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AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JANUARY 6, 1902.

The Market for Gas Securities.

The market for city gas shares has fairly maintained the strength recently shown by it. Consolidated sold up to 220¾, and closed to-day (Friday) at 218¾ to 219. Our first quotation reported for it in 1901 was 193. For the year ended December 31 the Stock Exchange reports the sale of 1,075,349 shares, the high price having been 238, the low 187, and the closing 219¼. The Company is in excellent condition, and there is nothing in sight to threaten its prosperity. Trading in other city gas shares is absolutely lifeless.

Brooklyn Union shows some signs of animation. The nominal figures for it are 210 to 212. In the year it was traded in on the Exchange to the number of 29,493 shares, the high figure being 228 and the low 175. Like its neighbor, the business of the concern is very satisfactory to its owners. Peoples, of Chicago, gains in value, as it should, for the figures quoted show in no sense its true worth. Baltimore Consolidated made a fair advance for the week, and Washington (D. C.) gas is eagerly inquired for at 335, bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JANUARY 6.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	218¾	219
Central Union, Bonds, 5's.	3,000,000	1,000	109½	111
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	295	305
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	108¾	109¼
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River .. Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	210	212
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	⅝	¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	95	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	8	10
" " Bonds, 5's	5,250,000	1,000	80¾	81¾
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,550,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	102	102½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	63¾	64¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000		..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	14
" Con. Mtg. 5's	380,000	1,000	79	83
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99¼	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	..	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	60	64
" Bonds, 6's	2 650,000	..	99½	101½
Jackson Gas Co	250,000	50	67	70
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	90	95
Preferred	2,500,000	100	105	108
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	109½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	5,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	103½	103¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	44	44¾
St. Paul Gas Light Co	1,500,000	100	60	63
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	84	86
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	93	96
Syracuse, N. Y.	1,750,000	100	14	16
Bonds	1,612,000	1,000	86½	89½
Washington, D. C	2,600,000	20	335	340
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	106½	108
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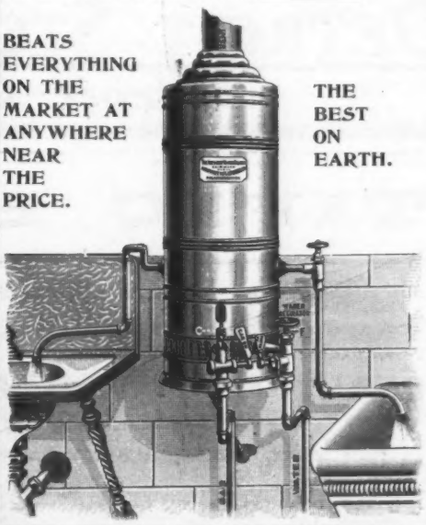

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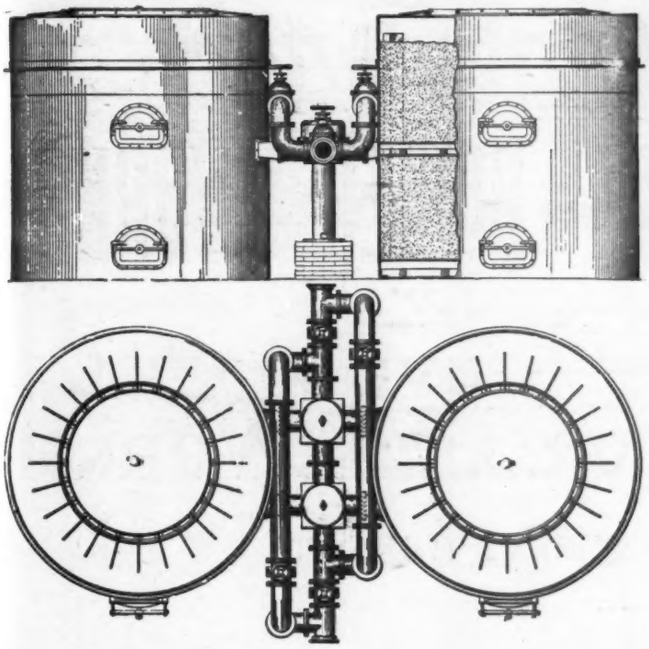

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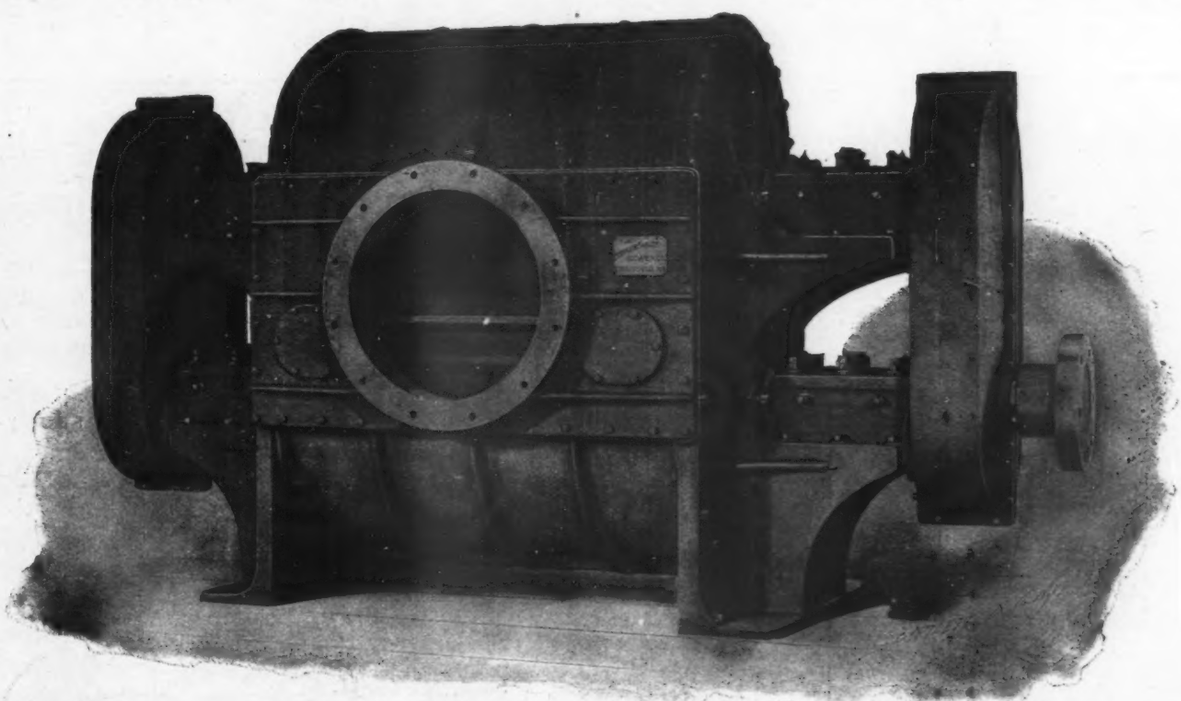

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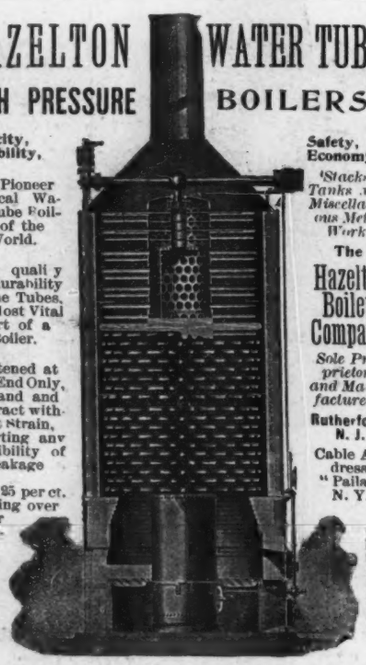

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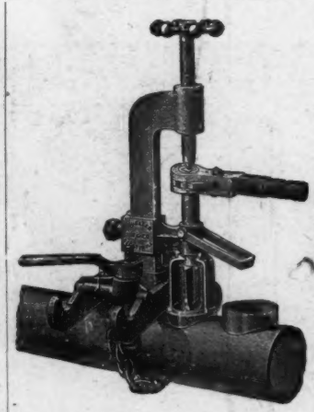

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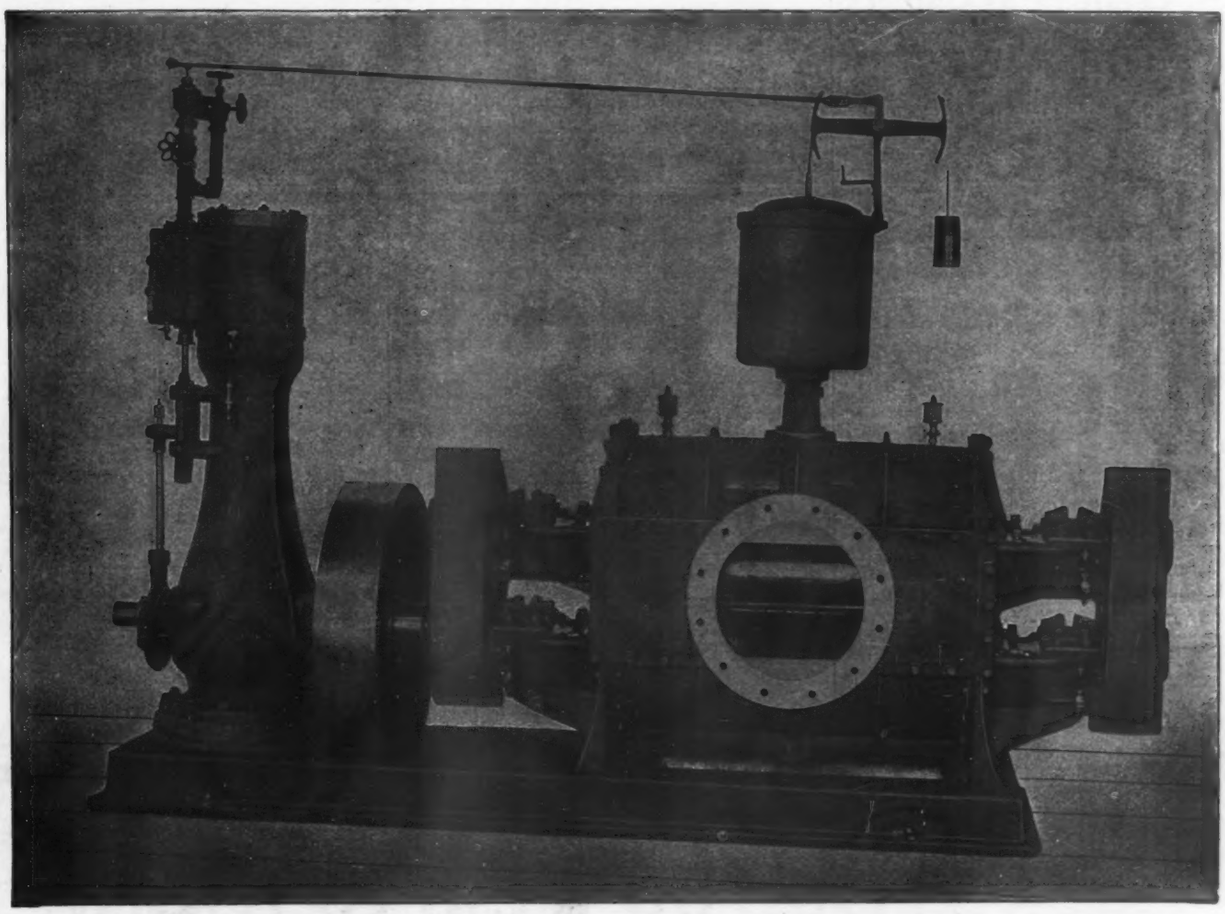

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CAST IRON FLANGE GAS and WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

GEORGE ORMROD, Manag'r. & Treas., Emaus, Pa.
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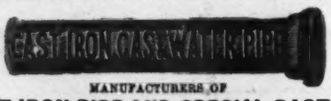
DONALDSON IRON COMPANY. EMAUS, PA.



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FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

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SAFETY GAS MAIN STOPPER Co.

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FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS

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Established 1856. Works at Phillipsburgh, N. J.

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER

FOR CLEANING BOILER TUBES.

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And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.
Rewritten and Much Enlarged by
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Eighth Edition, Revised, with Notices of Recent Improvements.

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FOR ASSESSMENT PURPOSES.

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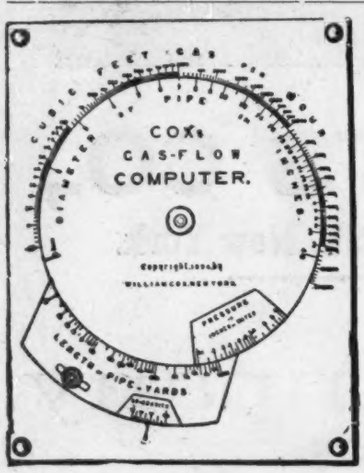

Do you wish to Know

what size of Pipe to use to convey any quantity of Gas, any distance, with any loss of pressure, and any initial or final pressure? Then use

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as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

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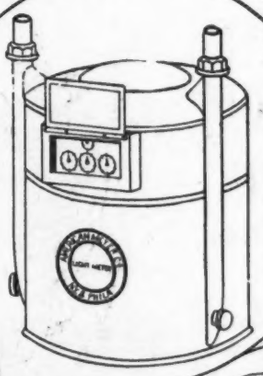

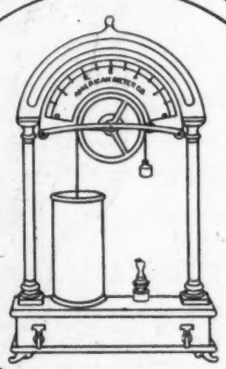

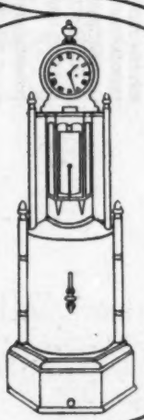

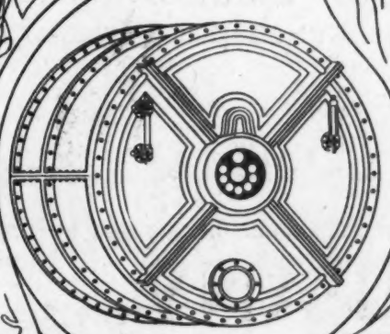

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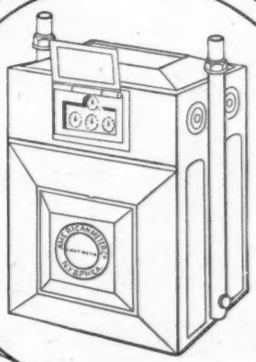
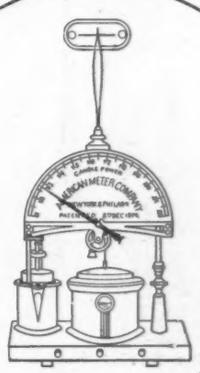
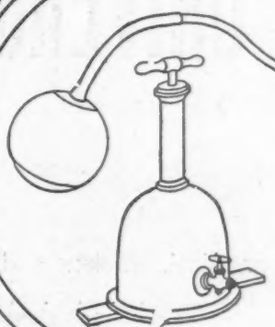
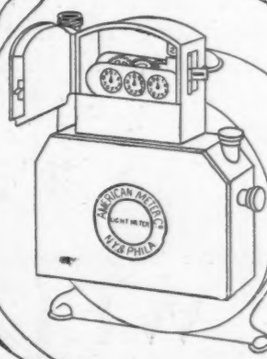








PUBLIC LIGHTING TABLE.

JANUARY, 1902.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	5.10 PM LQ	1.40 AM	4.30	6.30
Thu.	2	5.10	2.40	4.30	6.30
Fri.	3	5.10	3.40	4.30	6.30
Sat.	4	5.10	4.30	4.30	6.30
Sun.	5	5.20	5.30	4.30	6.30
Mon.	6	5.20	6.20	4.30	6.30
Tue.	7	5.20	6.20	4.30	6.30
Wed.	8	5.20	6.20	4.40	6.30
Thu.	9	5.20 NM	6.20	4.40	6.30
Fri.	10	5.20	6.20	4.40	6.30
Sat.	11	5.20	6.20	4.40	6.30
Sun.	12	5.20	6.20	4.40	6.30
Mon.	13	5.20	6.20	4.40	6.30
Tue.	14	9.10	6.20	4.40	6.30
Wed.	15	10.20	6.20	4.50	6.25
Thu.	16	11.30 FQ	6.20	4.50	6.25
Fri.	17	12.30 AM	6.20	4.50	6.25
Sat.	18	1.40	6.20	4.50	6.25
Sun.	19	2.50	6.20	4.50	6.25
Mon.	20	3.50	6.20	4.50	6.25
Tue.	21	4.50	6.20	4.50	6.25
Wed.	22	No L.	No L.	5.00	6.25
Thu.	23	No L. FM	No L.	5.00	6.25
Fri.	24	No L.	No L.	5.00	6.25
Sat.	25	5.40 PM	8.20 PM	5.00	6.25
Sun.	26	5.40	9.30	5.00	6.25
Mon.	27	5.40	10.30	5.00	6.25
Tue.	28	5.40	11.30	5.00	6.25
Wed.	29	5.40	12.30 AM	5.05	6.15
Thu.	30	5.40	1.30	5.05	6.15
Fri.	31	5.40 LQ	2.20	5.05	6.15

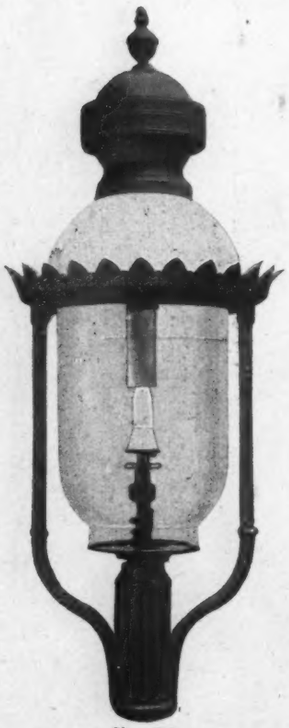
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

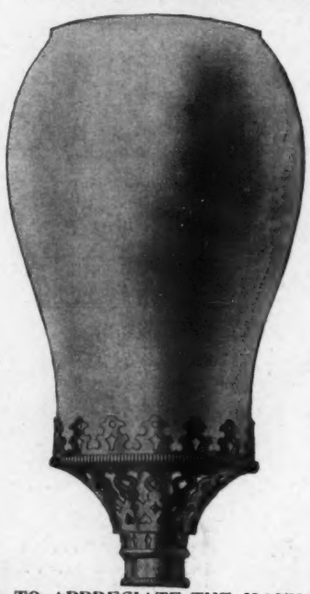
IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.

No. 38.

UNIVERSAL WELSBACH BURNER.



The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

It can be used with all styles and sizes of glassware, either shades or globes. No further necessity to carry a stock of different burners for the many sizes and shapes of glassware.

GAS COMPANIES AND DEALERS CANNOT FAIL TO APPRECIATE THE MANY SALABLE FEATURES OF THIS NEW BURNER.

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GLOUCESTER, N. J. CHICAGO, ILLS.

Salesrooms in all the Leading Cities of the United States.

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

The capacity of apparatus installed, if operated continuously, is sufficient to make more than the entire amount of artificial gas annually sold in the United States.

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CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

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Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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S. D. MERTON & CO.,
CONTRACTORS AND FURNACE BUILDERS,
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Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

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Works,
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—ESTABLISHED 1864.—

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Fire Clay Goods for Gas Works.

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Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Kegs, 100 to 200 " " 6 " "
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For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

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OAKHILL GAS RETORT & FIRE BRICK W'KS

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Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
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BALTIMORE
RETORT & FIRE BRICK CO.

MANUFACTORY AT
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Clay Retorts, Blocks & Tiles

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AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

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Sole Agents for New England States.

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General Manager.

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CORRESPONDENCE IS RESPECTFULLY SOLICITED.

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Having severed my connection with the American Gas Company, of Philadelphia, I beg to announce that, on and after January 1st, I shall carry on the construction business as the General Manager of the Connelly Iron Sponge and Governor Company, 395 Broadway, New York City.

I have recently returned from England, where I secured the agency for the United States of the Jonas Drake & Son system of Inclined Retorts, whose efficiency and results I consider at least equal to any in the world. This agency was secured after a very careful investigation of the merits of those benches in operation in some of the well known English works, and I can heartily recommend them to anyone interested.

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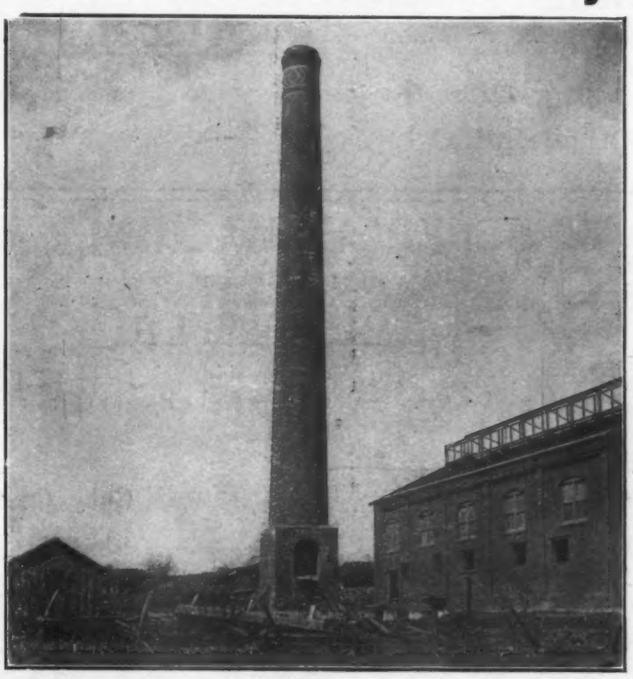
I shall also retain the Eastern Agency for the well known and reliable P. H. & F. M. Roots' Co. Exhausters, and will be prepared to undertake any and all kinds of construction work for Gas Companies. Very respectfully, **GEO. G. RAMSDELL.**

ADAM WEBER SONS,

Manhattan Fire Brick & Enameled Clay Retort Works,

Designers and Builders of Chimneys of Perforated Radial Bricks.



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A. M. Young, President, New England Engineering Co., New York, March 30th, 1901.

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H. P. HAMPSON,
General Manager New England Engineering Company, at Nazareth, Pa.

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The Gas Engineer's Laboratory Handbook,

By JOHN HORNBY, F.I.C.

Price, $2.50.

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By MAURICE GRAHAM, Assoc M. Inst. C.E.

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228 and 229 Produce Exchange, New York City.

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BERWIND-WHITE COAL MINING COMPANY'S

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STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
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Church's Patent Trays.

Reversible; Strongest; Most Easily Repaired.
Special Trays for Iron Sponge.

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We also Supply the Cheapest and Strongest
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PRESSURE GAUGE.
For continuous records of
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Simple in construction, accurate in operation and low in price.
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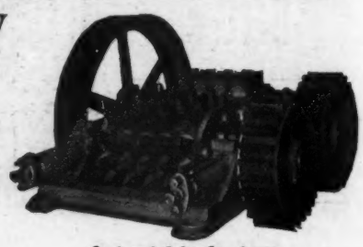
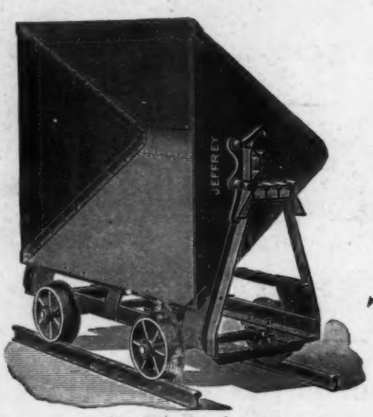
Silver Medal, Paris Exposition.

JEFFREY MACHINERY
FOR HANDLING
COAL, COKE, ETC.

DESIGNED TO SUIT THE CONDITIONS.


Coal and Coke Crushers.



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Shaking Screens. . . . . .
Power Transmission Machinery.

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By NORTON H. HUMPHRYS. Price, $2.40,
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KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

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Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

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Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

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Tilting Coal and Coke Car.

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Tilting Coal and Coke Cars, Breaker Rolls, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

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THE SUN OIL CO.

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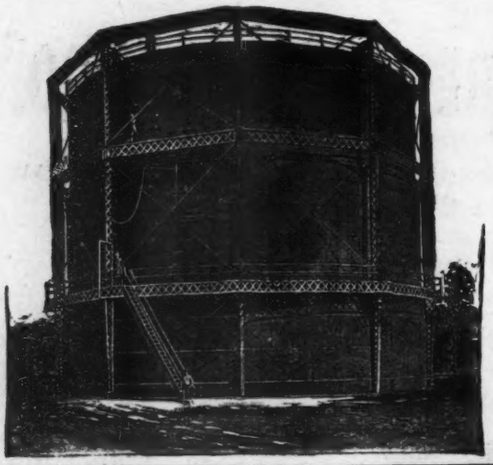

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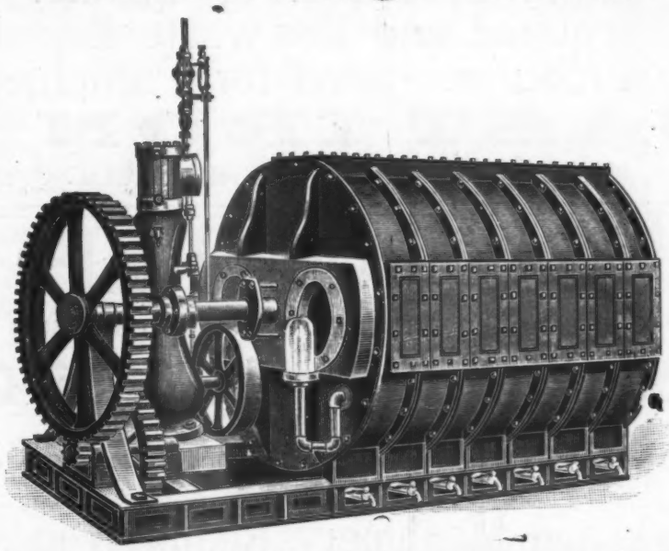

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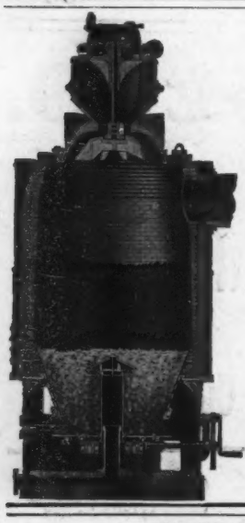

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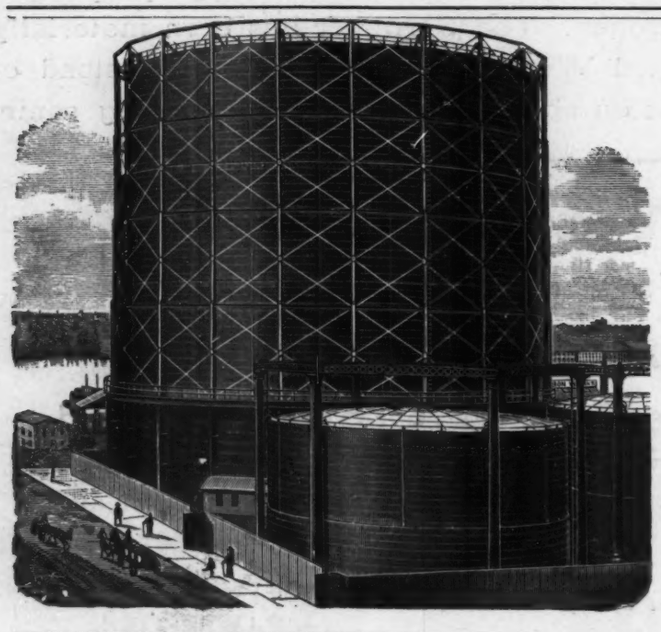

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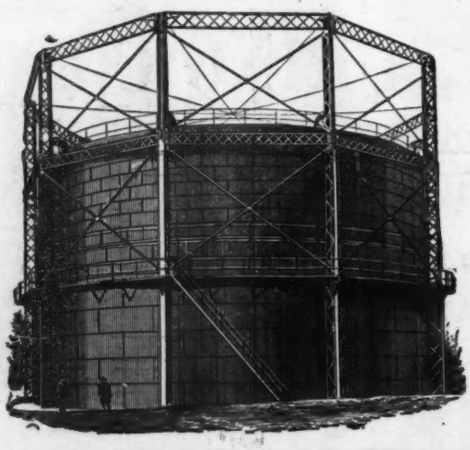

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